Regency® COMMUNICATIONS INC.

SERVICE MANUAL

MICRO-COM SERIES
And
BTH "A" SERIES

VHF FM TRANSCEIVERS

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This Service Manual is applicable to the following VHF FM Transceivers

MICRO-COM 21
MICRO-COM 21h
MICRO-COM 21t
BTH - 201
MICRO-COM 22
MICRO-COM 22h
MICRO-COM 21th
BTH - 202
MICRO-COM 24
MICRO-COM 24h
MICRO-COM 24s
BTH - 204

MICRO-COM SERIES SERVICE MANUAL

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SECTION 1 GENERAL INFORMATION

1-1 DESCRIPTION

The Regency MICRO-COM VHF series are transistorized FM transceivers designed for operation in the VHF (150-174 MHz) communications band. The MICRO-COM 21 and 21t, MICRO-COM 22, MICRO-COM 24 and 24s models are one, two, and four channel units respectively which operate in the 150 to 162 MHz segment of the band. The MICRO-COM 21h and 21th, MICRO-COM 22h, and MICRO-COM 24h are one, two, and four channel units respectively which operate in the 162 to 174 MHz segment of the band.

The transmitter and receiver sections can be pre-tuned to any frequency within the specified segment of the band (150-162 MHz or 162-174 MHz). The two sections are independently tuned, thus either one can be tuned to a different frequency (within the proper segment) than the other. However, the maximum frequency spread for the transmitter section is 1 MHz, while the receiver frequency spread is 3 MHz. In other words, the maximum difference between the lowest and highest frequency is 1 MHz for transmit frequencies and 3 MHz for receive frequencies.

The receiver section is a double-conversion, super-heterodyne type receiver. Silicon transistors (13) are utilized for dependability under widely varying ambient conditions. Also, two Integrated Circuits are used, providing for compactness and circuit reliability. A crystal first IF filter and a ceramic second IF filter are employed for optimum performance where numerous channels are active within the same area of the country.

The transmitter section also utilizes silicon transistors (8) throughout. Two ruggedized RF power transistors (BET or Balanced Emitter transistor type) are employed for high power output, which typically is 22 watts. A large, copper heat sink ensures that there is virtually no power drop off during lengthy transmissions. In addition, an SWR Bridge Limiting Circuit provides the necessary protection to the RF power transistors in the event the antenna or its coaxial feedline becomes open or shorted.

The transmitter employs phase modulation for the ultimate in carrier stability. Internal controls are provided for setting the amount of deviation. The deviation control is adjusted for a maximum of ±5 KHz deviation, in conformance with FCC regulations.

The attenuation of spurious emissions from the transmitter, RF power output, frequency stability, performance under varying conditions of temperature and battery voltage, and other specifications, all exceed the limits required for Type Acceptance by the Federal Communications Commission.

NOTE: The Regency Type MICRO-COM 21, MICRO-COM 21t, MICRO-COM 22, MICRO-COM 24, and MICRO-COM 24s are type accepted under Parts 21, 81, 89, 91, and 93 of the F.C.C. Rules and Regulations.

The Regency Type MICRO-COM 21h, MICRO-COM 21th, MICRO-COM 22h, and MICRO-COM 24h are type accepted under Parts 21, 89, 91, and 93 of the F.C.C. Rules and Regulations.

1-2 SPECIFICATIONS

RECEIVER

Antenna Impedance	50 Ohms
Frequency Range (MICRO-COM 21, 22, 24, 24s, 21t)	150.0-162.0 MHz
Frequency Range (MICRO-COM 21h, 22h, 24h, 21th)	162.0-174.0 MHz
Channels	1, 2, or 4; Crystal Controlled
Sensitivity	0.35 µv (nom.), 20 DB Quieting
Sensitivity Bandwidth	3 MHz
Adjacent Channel Selectivity	80 DB
Image Rejection	60 DB
Spurious Rejection	70 DB
Modulation Acceptance Bandwidth	±7 KHz
Carrier Squelch Sensitivity	0.2 µv
Audio Output (3-4 Ω Speaker)	3 Watts @ 10%, or less, distortion; 5 Watts, maximum
FCC Certified	Part 15, Subpart C

TRANSMITTER

Antenna Impedance	50 Ohms
Frequency Range (MICRO-COM 21, 22, 24, 24s, 21t)	150.0-162.0 MHz
Frequency Range (MICRO-COM 21h, 22h, 24h, 21th)	162.0-174.0 MHz
Channels	1, 2, or 4; Crystal Controlled
Frequency Stability	±.0005% (-30°C to +60°C)
Power Output	20 Watts (min.) @ 13.8 VDC
Power Bandwidth	1 MHz
Spurious & Harmonic Rejection	57 DB (min.)
FCC Emission Designator	16F3
Deviation	Factory adjusted to ±5 KHz; internal adjustment of 0-7 KHz
FCC Type Accepted (MICRO-COM 21, 22, 24, 42s, 21t)	Parts 21, 81, 89, 91, and 93
FCC Type Accepted (MICRO-COM 21h, 22h, 24h, 21th)	Parts 21, 89, 91, and 93

CTCSS ACCESSORY

Frequency Range	EIA Standard Frequencies from 67.0 to 250.3 Hz
R.F. Sensitivity	0.15 μv
Response Time	325 mS (max.)
Encode Deviation	Adjustable, 0 to ±1 KHz

SCAN ACCESSORY

Scan Rate	Approx. 15 Ch/sec.
Channel Spacing	Equal to max. Receiver Operating Bandwidth
R.F. Sensitivity	Equal to Receiver Threshold Carrier Squelch Sensitivity

POWER

Voltage Requirements	13.8 VDC (nominal) 12.0 to 16.0 Volts
Current Requirements	@ 13.8 VDC
Receive (Squelched)	130 MA.
Receive (Max. Audio Output)	800 MA.
Crystal Heaters (On State)	260 MA. (max.)
Transmit	4.0 Amps (max.)
Fuse Size	5 Amp., 3 AG

SEMI CONDUCTORS

Integrated Circuits	3
Silicon Transistors (Total)	23
BET RF Power Transistors	2
Field Effect Transistor	1
Diodes (Total)	15
Varactor Diodes	2
Zener Diodes	3
Signal Diodes	4
Rectifier Diode	1
Light Emitting Diodes (LED)	5

GENERAL

Front Panel Size	5 5/8" x 2 5/16"
Depth (Including Knobs and Rear Panel Connectors)	9 in.
Weight (Including Microphone and Mounting Equipment)	3 lbs. 13 oz.
Antenna Connector	SO-239
Speaker Size	4 inch, square

1-3 EQUIPMENT SUPPLIED

a. 1 - Transceiver unit
b. 1 - Microphone and Connector
c. 1 - Mobile Mounting Bracket
d. 1 - Mobile Mounting Hardware
e. 1 - Security Bracket
f. 1 - DC Power Cord and Fuse
g. 1 - Owner's Instruction Manual
h. 1 - External Speaker Connector

1-4 EQUIPMENT AVAILABLE, NOT SUPPLIED

a. Telephone Handset (MA-79)
b. Microphone (replacement use) (MA-83)
c. D.C. Power Cord (replacement use) (MA-84)
d. Accessory Plug Kit (MA-85)
e. Tone Module Field Kit for M-C21 conversion to C.T.C.S.S. (MA-86)
f. Cigarette Lighter Power Cord (MA-87)

1-5 EQUIPMENT NOT SUPPLIED

a. 1 - Antenna
b. 1 - Coaxial Cable feedline
c. 1 - Coaxial Cable Connector
d. 1 - Power Supply (battery)
e. 1 - Padlock (used with Security Bracket)

1-6 INSTALLATION

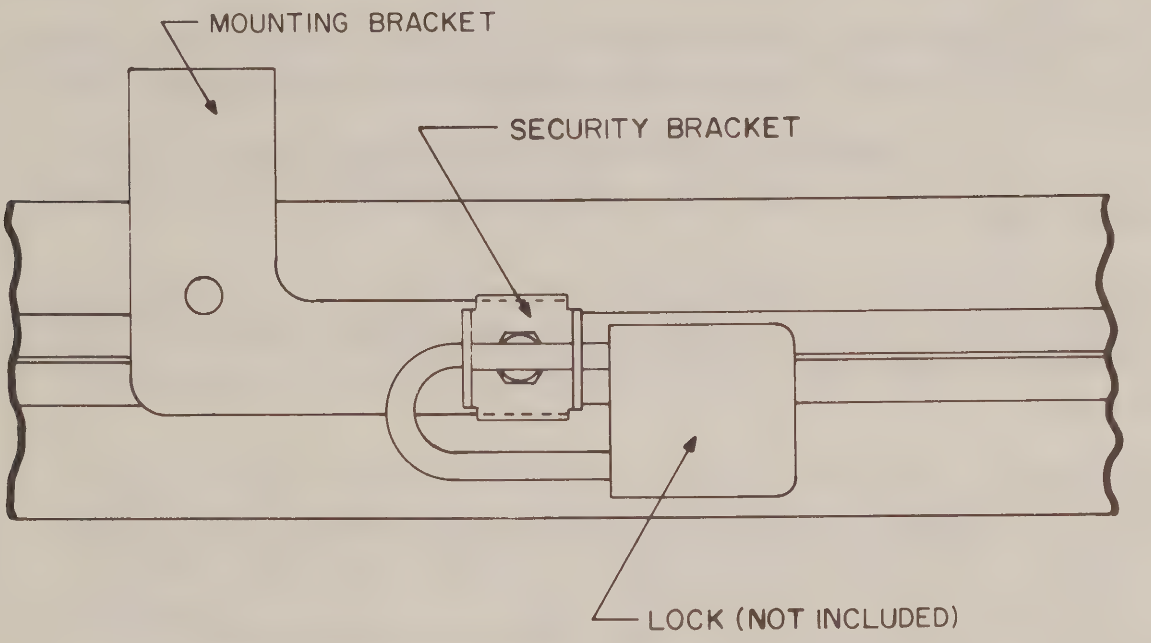
Mobile (12 VDC) Installation:

The MICRO-COM series transceivers are designed for installation in any vehicle that has a 12 VDC negative ground system The RED lead, with the fuse holder, must be connected to the POSITIVE (+) terminal side of the battery. The BLACK lead should be connected to the NEGATIVE (-) terminal side of the battery, or to a metal chassis that is grounded to the negative terminal. In the event that the battery is remotely located, it may be necessary to install additional wires for properly connecting the radio to the battery's terminals.

Due to the use of the Mic Hang-up to control a function in the MICRO-COM 21t, 21th, and 24s, it is important that the hanger clip be securely grounded. If this is not accomplished by the mounting screws (many new vehicles have plastic dash boards) a separate wire must be added connecting to electrical ground or directly to the transceiver chassis.

THE ANTENNA USED SHOULD BE PROPERLY ADJUSTED FOR THE 50 OHM OUTPUT OF THE TRANSMITTER. A HIGH SWR WILL REDUCE THE POWER OUT, OR MAY EVEN SHUT OFF THE TRANSMITTER ENTIRELY.

To reduce the possibility of theft, the Security Bracket should be installed as shown in Figure 1-1. The padlock used should be of substantial construction and can be either a key of combination operated type.

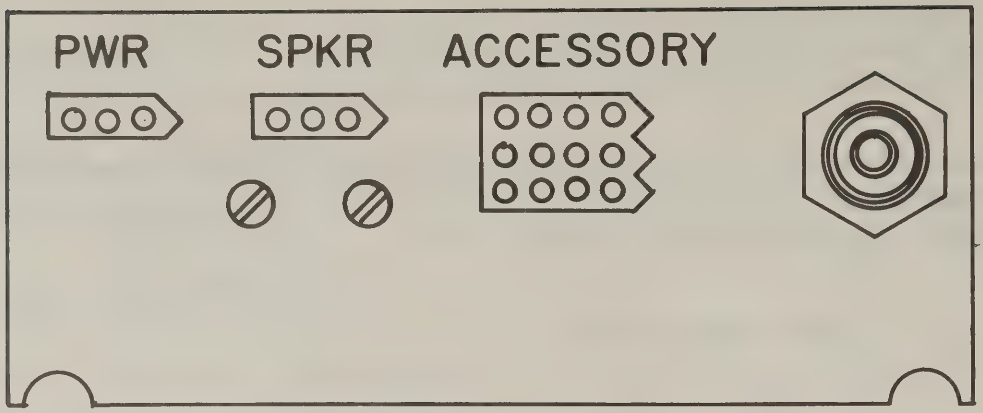


SIDE VIEW SHOWING SECURITY BRACKET INSTALLATION

SIDE VIEW SHOWING SECURITY BRACKET INSTALLATION FIG 1-1

Connections for an external (or remotely mounted) speaker are provided. These terminals are connected to the audio output and may be used as a convenient test point. In permanent installations, the internal speaker should be disconnected. The use of a 3 to 4 ohm external speaker (Regency MA-8) is recommended.

The remaining connector has no wiring installed and is provided for the users' convenience in connecting various special functions, accessories, etc. For wiring this connector, the Regency MA-85 Kit provides all necessary items.



REAR VIEW SHOWING CONNECTORS FIG 1-2

1-7 OPERATION

The OFF-ON Switch is an integral part of the VOLUME control. Turning this control fully counter-clockwise until a click is heard will turn the unit off. Maximum volume, or audio output, occurs when the volume control is turned fully clockwise.

The receiver's audio is squelched off when the SQUELCH control is turned COUNTER-CLOCKWISE. Turning this control counter-clockwise until the noise just disappears (threshold squelch) permits the receiver to be "quiet" until an actual signal is received. With the squelch control set fully counter-clockwise, the receiver will still operate properly and will not be locked-out (prevented from responding to a received signal).

The MICRO-COM 22 and 22h are capable of operating on either of two frequencies. The desired channel is selected by depressing the button corresponding to the desired channel F1 or F2, the Indicator Lamp will light for that channel. NOTE: Do Not depress more than one button, improper and possibly illegal operation will result.

The MICRO-COM 24, 24h, and 24s are capable of operating on any one of four frequencies. The desired channel is selected by turning the Channel Selector to the position corresponding to the desired channel F1, F2, F3 or F4, the Indicator Lamp will light for that channel.

A high impedance ceramic microphone is supplied with the unit. To install the microphone on the unit, insert the connector plug into its socket with the locating tab toward the bottom of the radio. The connector is then locked into place by rotating the locking ring 1/4 turn clockwise.

To transmit a message, it is only necessary to press the push-to-talk button on the microphone and speak into the microphone. The Transmit Indicator will come on to signify that the transmitter is activated. Best results are obtained by holding the microphone about one inch from the lips and inclined at about a 30 degree angle away from the face. Speak clearly in a normal tone of voice across the face of the microphone.

1-8 CRYSTAL SPECIFICATIONS

Miniature plug-in crystals are utilized by both the receiver and transmitter sections. Because of the high accuracy (close tolerance) required, Regency crystals are recommended. Either receive or transmit crystals must be ordered by specifying the Channel Frequency and Part No. 2311-0000-000 for Receive or Part No. 2312-0000-000 for Transmit. Use of other manufacturers' transmit crystals may cause violation of the FCC Rules and Regulations.

If desired, the RECEIVE crystals may be purchased from other manufacturers. The following specifications must be included in the order:

a. Crystal Frequency, determined as follows:

$$\text{Crystal Frequency} = \frac{\text{Receive Frequency } -10.7\text{ MHz}}{3}$$

EXAMPLE:

$$\text{Crystal Frequency} = \frac{156.300\text{ MHz } -10.700\text{ MHz}}{3}$$

Crystal Frequency = 48.533 333 MHz

b. Frequency Tolerance of .001% @ 25°C; .002% from -10 to +60°C

c. 3rd Overtone

d. Series resonance minus 600 Hz

e. Maximum equivalent series resistance of 35 ohms

f. Drive Level of 2 MW (max.)

g. Holder: HC-25/U

1-9 CRYSTAL INSTALLATION

Prior to installing a crystal, the transceiver's cover will have to be removed. To remove this cover, unscrew the two large bolts located at the sides of the unit. The cover may then be slipped off by sliding it toward the rear of the unit.

Next, the speaker should be removed. Unscrew the two small metal screws (one located on each side) holding the speaker mounting brackets in place. Then carefully place the speaker assembly along side of the unit.

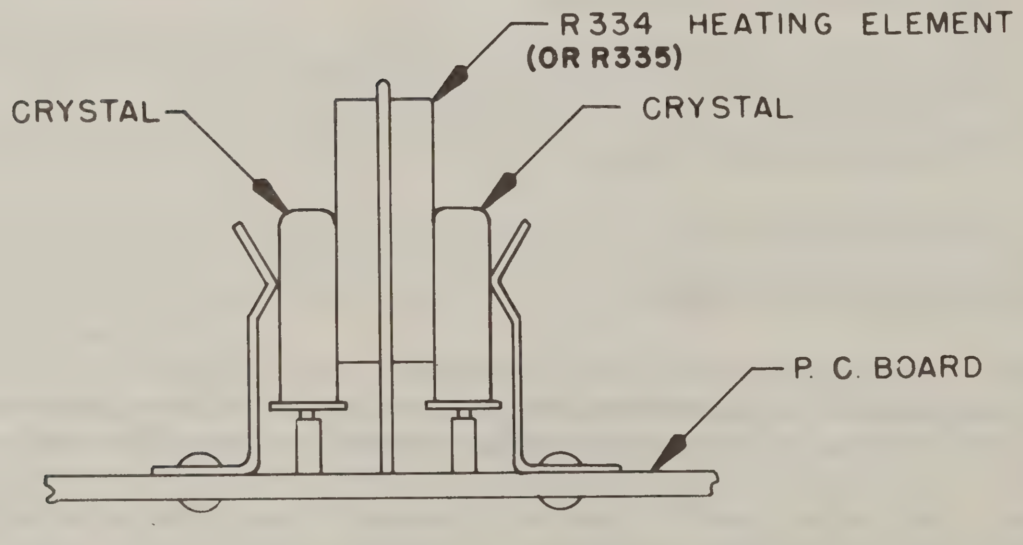
See Figures 1-3 and 1-4 for proper Crystal Location and Installation. Insert the Receive crystal in the proper channel; be sure the crystal is firmly seated in the socket pins.

Special care must be taken to install the TRANSMIT crystal, correctly. The conduction type crystal heater, which is used to heat the crystals at a very low ambient temperature, relies on having proper physical contact between the heater element and the crystal for effective operation. The Crystal Heater Detail (Figure 1-3) demonstrates the correct method of crystal installation. The crystal must be pressed down into the socket pins far enough for the rim around the bottom of the crystal to clear the heating element and allow good contact between the side of the crystal and the element.

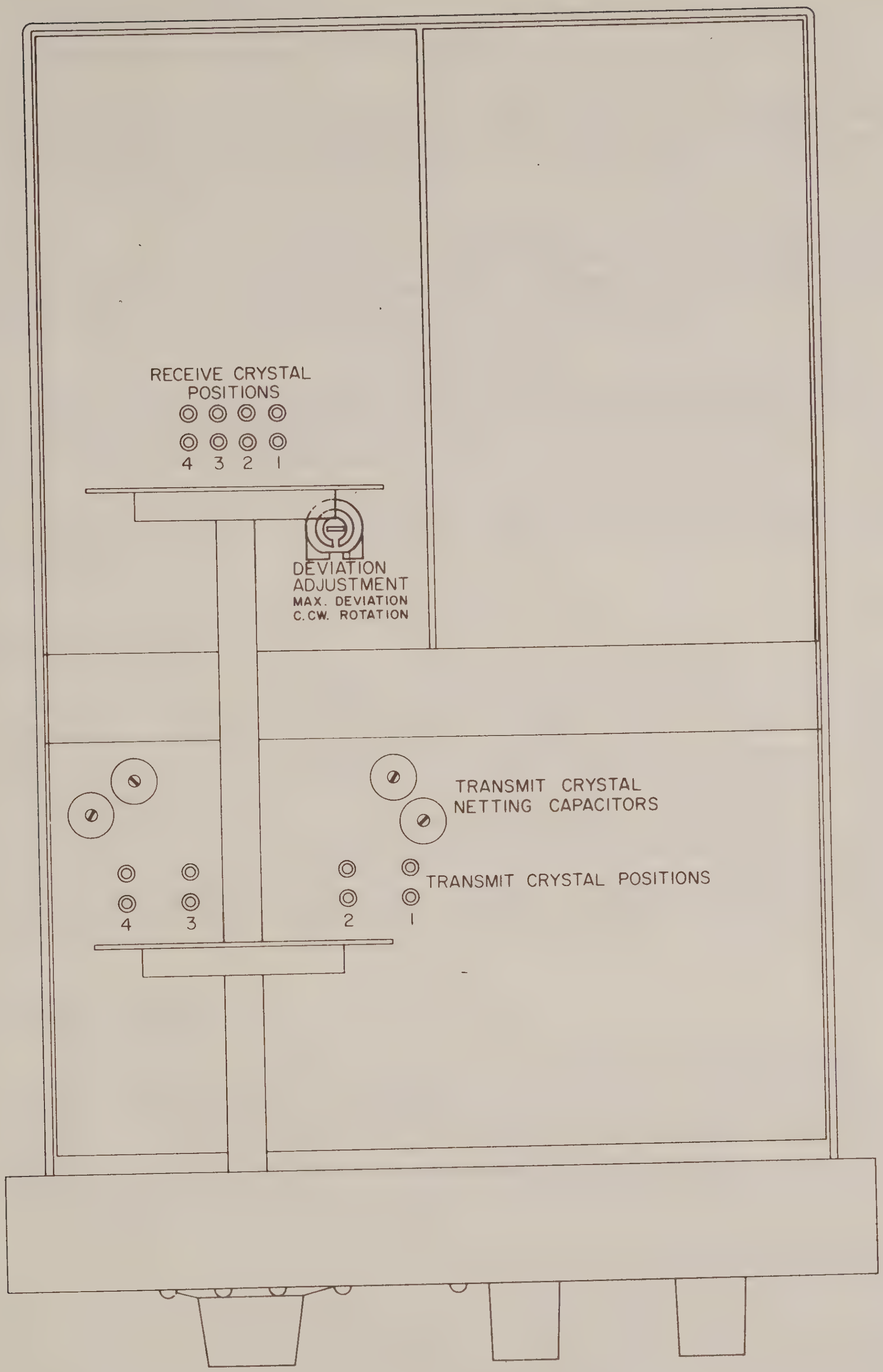
For the TRANSMIT crystal, there is a variable capacitor that is to be used for "Netting" (adjusting to the exact frequency) purposes. This netting should be made with an accurate frequency counter, such as Regency EC-175. See 3-8 for detailed Crystal Netting Procedure.

> NOTE: FCC Regulations require that the TRANSMIT crystal be installed and adjusted "on frequency" under the supervision of a technician holding either a First or Second Class FCC license.

After the crystals are installed, and netted, reinstall the speaker assembly. Then, carefully reinstall the cover and its hardware.



CRYSTAL HEATER DETAIL FIG 1-3


RECEIVE CRYSTAL POSITIONS
4 3 2 1
DEVIATION ADJUSTMENT
MAX. DEVIATION C.CW. ROTATION
TRANSMIT CRYSTAL NETTING CAPACITORS
TRANSMIT CRYSTAL POSITIONS
4 3 2 1

CRYSTAL LOCATION DIAGRAM FIG 1-4

SECTION 2 CIRCUIT DESCRIPTIONS

2-1 RF — TRANSMITTER BOARD

Q201 is an RF amplifier with broad-band tuned circuits in its input and output circuitry. The output of the RF amplifier is coupled to the input of the mixer, Q202, a Field Effect transistor.

The first L.O. (local oscillator), uses third overtone crystals. (The number marked on the crystal is the receive frequency). Oscillator injection to the mixer is accomplished by mutual coupling between the windings of T201.

The 10.7 MHz output frequency from the mixer is coupled to the first selectivity element XF-201 and XF-202 which form a 4-pole crystal filter; output from the filter is coupled to the 10.7 MHz IF input.

The Transmit Audio Section of this board is described in 2-5 in conjunction with the transmitter board.

2-2 DIODE SWITCHING BOARD

This board, used only on the MICRO-COM 22 and 22h, contains a diode switching matrix which enables the push button frequency-select switch to remotely control the receive channel selected by switching a DC current only. When channel one is selected by depressing the F1 button on the front of the unit, SW2B applies a ground to R701, causing CR702 to conduct in the forward direction. Y201 is thus "switched in" through the low forward resistance of CR702. When SW2B is closed, interlocked SW1B is open, causing CR701 to be reverse biased. The high reverse resistance of CR701 "switches out" Y202. When the F2 button is pressed, the reverse of the above occurs.

2-3 IF — AUDIO BOARD

The IF input circuitry consists of T101 and Q101, used as an IF amplifier. The output of this amplifier is fed to an Integrated Circuit, IC101, which contains the second mixer and L.O. circuitry, operating at 10.245 MHz. In some locations where a strong secondary Image Signal has been encountered, this oscillator's frequency is moved to 11.155 MHz. (The crystal frequency is stamped on the top of the crystal).

The 455 KHz output of IC101 (terminal 5) is coupled through a tuned circuit to the input of the second selectivity element, CF101, a ceramic filter centered at 455 KHz. The output of CF101 is coupled through another tuned circuit to the input of Integrated Circuit IC102. IC102 is a series of amplifiers providing approximately 60 DB gain at 455 KHz. Also included in IC102 is the limiting circuitry and a quadrature detector circuit. L103, connected between terminals 2 and 12 of IC102, is the adjustable quadrature coil.

The audio output from IC102 (terminal 1) is coupled to the input of the audio amplifier circuit and to the input of the noise-operated squelch circuit.

Transistor Q102 is an amplifier whose frequency response extends from approximately 5 KHz to 25 KHz. Q102 amplifies the "noise" occuring in this frequency range. The noise is coupled to the base of Q103. Q103 is used as a detector which rectifies the amplified noise and produces a DC voltage at its collector. When the DC voltage at the collector of Q103 is positive and of sufficient value to provide base bias for Q104, Q104 turns on and provides essentially a short circuit between the base of Q105 and ground. This action turns off Q105 and the audio output from the receiver is squelched (muted). When a signal (carrier) arrives, the noise input to the detector (Q103) is reduced to the point where the DC voltage at the base of Q104 is no longer sufficient to cause Q104 to conduct.

At this time, the audio pre-amplifier (Q105) is allowed to operate normally and its audio output is applied through the volume control to the base of the audio amplifier, Q106. Q106 supplies a signal to the audio driver transistors, Q107 and Q108. The output transistors, Q109 and Q110, form a quasi-complementary, transformerless stage capable of delivering 5 watts to the speaker.

2-4 LED DISPLAY BOARDS

Channel Indicator:

When a particular channel is selected, the cathode of that channel's LED indicator is grounded and voltage to the LED is provided by the transceiver's supply voltage.

Transmit Indicator:

The Transmit Indicator (LD405) functions similarly, except that the cathode is already grounded and voltage to the LED is provided by the transmitter supply voltage.

Pilot Lamp:

The Power Indicator (LD406) is supplied current from the main A+ line and is on whenever SW3 is closed.

Call Indicator:

The Call Indicator (LD-401) is supplied current by Q804 on the C.T.C.S.S. accessory being switched "on" to ground.

2-5 TRANSMITTER BOARD

Q308 is in a crystal oscillator circuit operating at approximately 13 MHz. Each crystal has a trimmer capacitor in series with it. This trimmer capacitor is used for fine (small) adjustments to the crystal's frequency.

The crystal heater assembly consists of R334 (or R335) and two spring clips. R334 (or R335) is located between two crystals in such a manner that the spring clips force the crystals into reliable physical contact with this resistor. Power dissipation in the resistor is sufficient to cause conduction heating of the crystals to above 0° when the ambient temperature is -30°C. Control circuitry consisting of Q309, Q310 and associated circuitry automatically adjust the power delivered to the crystal heaters. Heater turn-on is nominally between 0°C and -5°C. Both heaters will be completely shut off at normal ambient temperatures. Refer to Figure 1-3 for detailed drawing.

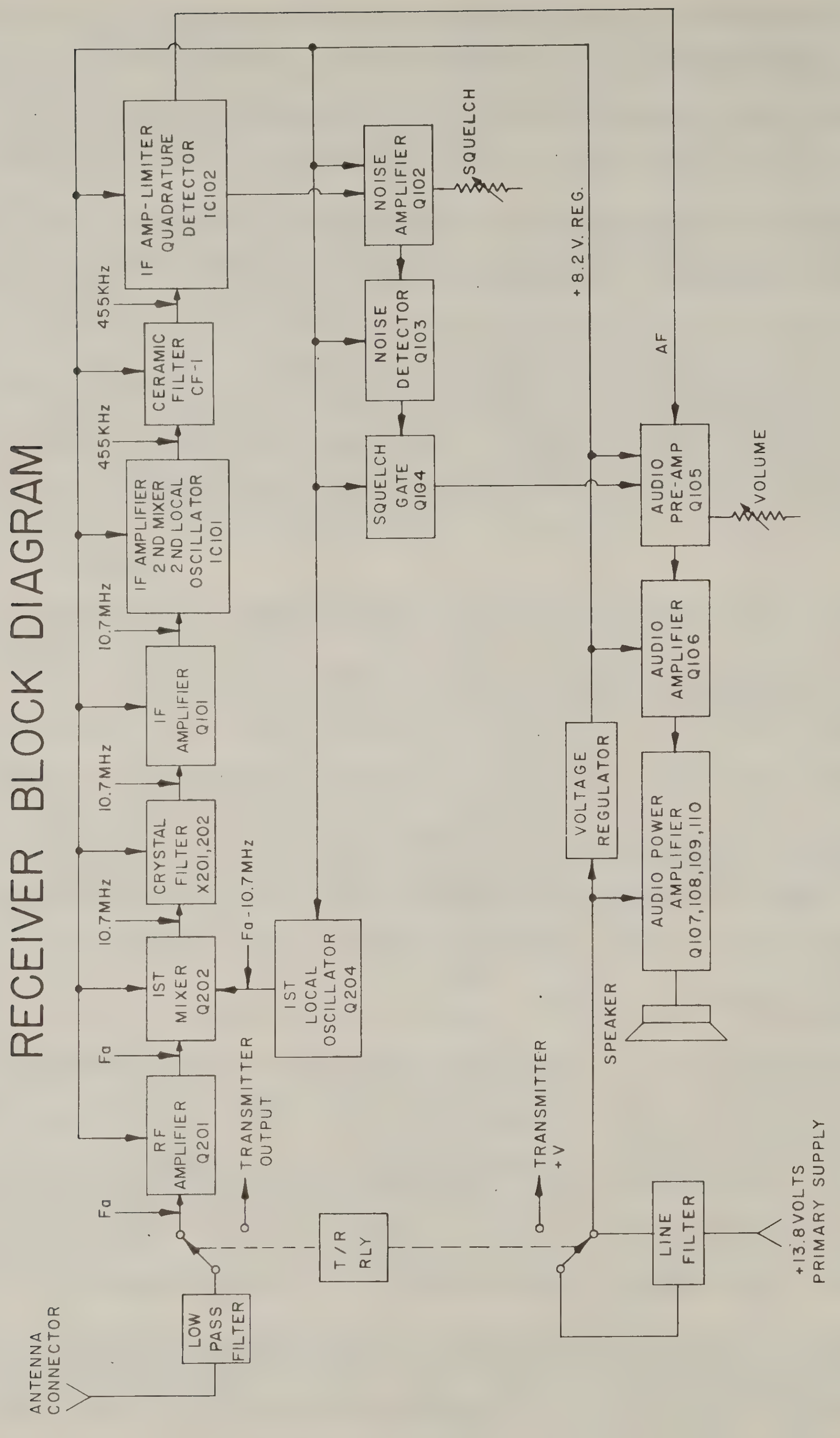
The oscillator's frequency is phase-modulated by two varactor diodes, CR302 and CR303, which are connected across a coil (L306) that is lightly coupled to the emitter circuit of the oscillator . L306 is tuned to the crystal frequency. The oscillator's phase-modulated output is applied to the base of Q307. Q307 is a multiplier whose output frequency is three (3) times the crystal frequency. The signal from Q307 is transformer coupled to the base of Q306. Q306 is used as a doubler, a stage that multiplies its inpur signal's frequency by two. Thus, the output frequency of Q306 is six (6) times the crystal frequency. This signal is then applied to Q303, which is also operating as a doubler. The frequency of the output signal from Q303 is twelve (12) times the crystal frequency. This frequency is the ultimate transmitter output frequency.

Q302 is a power amplifier operating "straight through". Q302 provides the drive (RF signal) required by the "final" stage, Q301, to deliver at least 20 watts of RF power to the antenna through the impedance matching network in its collector circuit. Q301, Q302 and Q303 operate in the Class C mode.

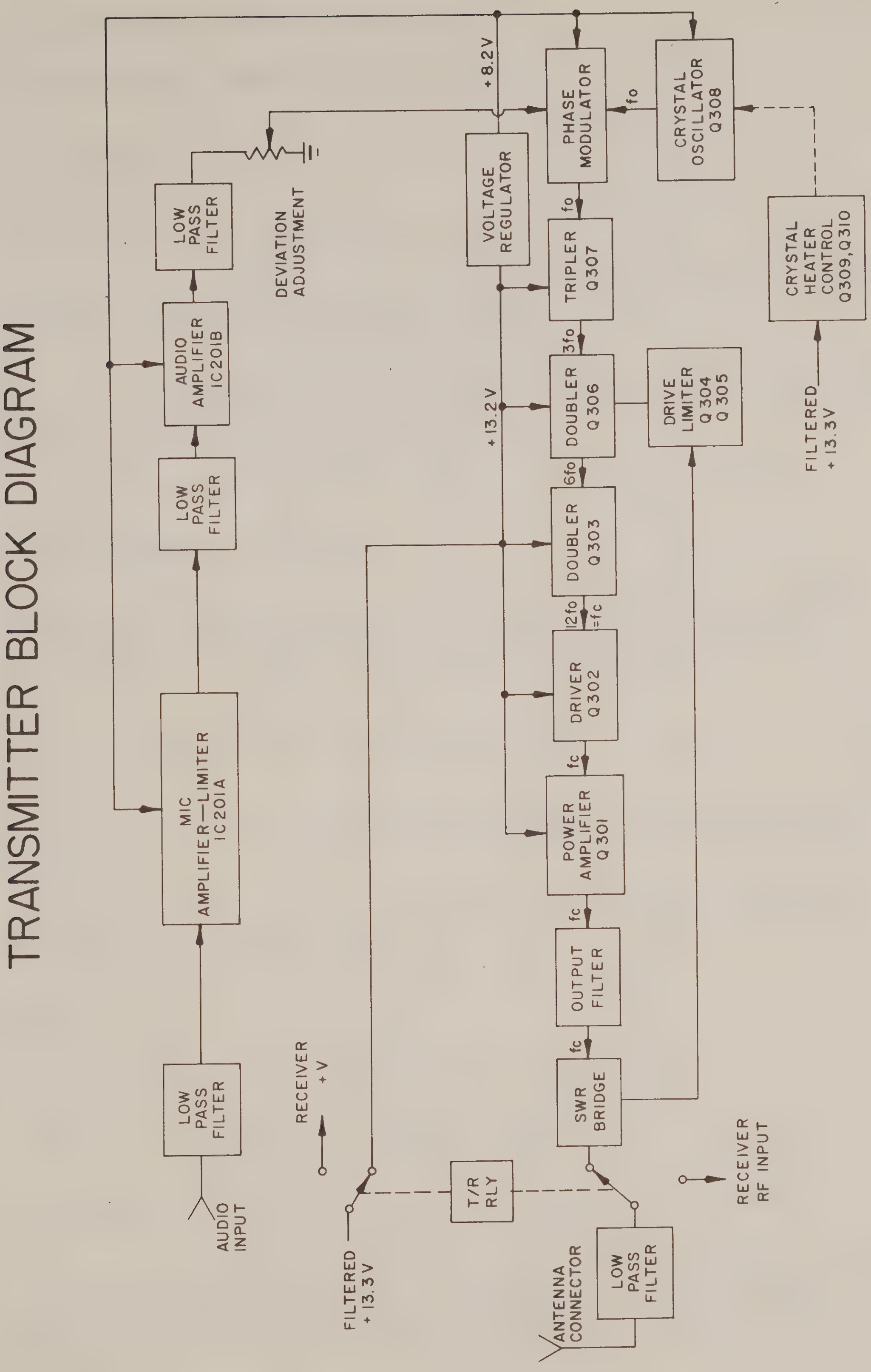
The transmitter output transistor, Q301 is protected from damage due to excessive SWR on the antenna transmission line by the SWR Bridge and Drive Limiter circuits. In the event of a load mismatch at the antenna connector, the SWR Bridge consisting of T301, R301, R305 and CR301 will detect the mismatch and send a signal to the Drive Limiter. The Drive Limiter (Q304 and Q305) will then bias Q306 in an off condition, preventing possible damage to the power amplifier (Q301). Load mismatch is detected by comparing the phases of output voltage and current to determine if standing waves exist on the feedline to the antenna.

The Transmitter Audio Section of the transmitter uses a Dual-Integrated-Circuit Operational Amplifier. Input signal from the high-impedance ceramic microphone is applied to the first amplifier section (IC201A) where it is amplified; when the input level, as amplified by IC201A, is large enough to turn on diodes CR201 and CR202, the circuit gain is reduced maintaining a maximum output level and preventing over-deviation of the transmitter. IC201B is an amplifier and low-pass filter to provide the proper frequency characteristic for the transmitted audio. R244 adjusts the signal level to the modulator diodes and thus is the deviation control.

The push-to-talk (PTT) Switch in the microphone applies a ground to the transmit-receive relay coil, which activates the relay. The T-R relay switches the supply voltage between the receiver and transmitter and switches the antenna between the receiver input and the transmitter output.



2-6 RECEIVER BLOCK DIAGRAM



2-7 TRANSMITTER BLOCK DIAGRAM

SECTION 3 ALIGNMENT AND TUNING PROCEDURES

3-1 EQUIPMENT REQUIRED — RECEIVER ALIGNMENT

3-1-1 FM Signal Generator
3-1-2 Oscilloscope
3-1-3 AC VTVM
3-1-4 Noise Generator (To Be Used In 3-5 Only)

NOTE: During all steps of alignment, the squelch control should be in the maximum clockwise position (minimum squelch action).

All transceivers should be aligned to the channel nearest the center of the frequency range over which they will operate.

Diagrams 4-1 and 4-5 show the location of all coils to be adjusted.

3-2 QUADRATURE DETECTOR ALIGNMENT

3-2-1 Connect the FM Signal Generator to the antenna input jack. Accurately set frequency to the center of the channel being used for alignment. Modulate Signal Generator with 1000 Hz, 3 KHz deviation.

3-2-2 Connect the oscilloscope to Test Point A, (Junction of C126, C128, R113). See diagram 4-4.

3-2-3 Adjust output of Signal Generator until all noise in scope pattern just disappears.

3-2-4 Adjust L103 for maximum peak to peak amplitude, while maintaining symmetry of the detected signal.

3-3 IF ALIGNMENT

3-3-1 Disconnect RF Signal Generator from antenna input.

3-3-2 Connect AC voltmeter across speaker terminals.

3-3-3 Adjust volume control for .5 volt noise reading on AC voltmeter.

3-3-4 Peak T102 (bottom core and top core, in that order) for maximum noise (maximum meter reading on AC voltmeter). If circuit is not badly misaligned, the correct point should be within 2 turns of the core's present position.

NOTE: Coils will have two peaks; adjust core to peak away from the center of the coil form.

3-3-5 Adjust Volume Control for 1.0 volt noise reading on AC voltmeter.

3-3-6 Connect the RF Signal Generator to the antenna input jack. Turn modulation off. Set the generator to the operating crystal frequency.

3-3-7 Set the Signal Generator so that the first I.F. frequency is exactly 10.7 MHz. This is best done by observing the heterodyne produced by an accurate 10.7 MHz source, such as that available from the Regency EC-175 Electronic Counter.

3-3-8 Using an appropriate Oscilloscope or A.C. Millivoltmeter, observe the signal at the input of the 455 KHz filter. Adjust the generator's output for a useful indication.

3-3-9 Adjust T101, L205, T102 (bottom core) and T102 (top core), (in that order), for maximum indication, reducing generator output if necessary to maintain an on-scale reading. If two peaks occur, use the one away from the center of the coil form in each case.

3-4 RF ALIGNMENT (RECEIVER)

3-4-1 Pre-set the cores of L201, L202, L203 flush with the tops of the coil forms.

3-4-2 Connect AC voltmeter across the speaker terminals.

3-4-3 With nothing connected to the antenna input, adjust the Volume Control until AC voltmeter reads 1 volt of noise.

3-4-4 Connect Signal Generator to antenna input jack. Set generator accurately to the center frequency of the channel being used for alignment. Turn modulation off.

3-4-5 Adjust output of Signal Generator until AC voltmeter reads .2 volts.

3-4-6 Adjust L201, L202 and L203, in that order, for maximum quieting (lowest meter reading). Adjust Signal Generator output to maintain voltmeter reading between .1 and .2 volts. Repeat adjustments until no further improvement can be made. If two peaks occur on any core, use the peak with the core nearest the top of the coil form.

NOTE: The following step may be omitted if performed in IF Alignment Section.

3-4-7 Adjust T102 (bottom core) and T102 (top core), in that order, for maximum quieting (lowest meter reading). Adjust Signal Generator to maintain reading on AC voltmeter between .1 and .2 volts. If two peaks occur, use the one away from center of the coil form.

NOTE: This adjustment may be required only if excessive "ignition noise" is encountered. Usually the "noise" problem is caused by improper or inadequate noise suppression of the vehicles ignition system.

3-5 NOISE BALANCE ADJUSTMENT

3-5-1 Using a "T" connector, connect the FM Signal Generator and the Noise Generator to the antenna input jack. If a "T" connector is not available, connect the FM generator to the antenna jack and feed in the noise signal by means of a 3 or 4 turn loop coupled to the input coil, L201.

3-5-2 Connect the Oscilloscope to the junction of Q109's emitter and Q110's collector, or to the speaker terminals.

3-5-3 Apply a 3 to 10 microvolt signal, as accurately as can be set to the exact channel frequency (carrier only, no modulation), and adjust the output of the Noise Generator until spikes are clearly seen in the audio output as viewed on the Oscilloscope. The noise spikes will be either mostly positive and negative if an unbalanced condition exists.

3-5-4 Turn L103 (Quadrature Detector Coil) until the noise spikes are equally positive and negative in their amplitude. The overall amplitude of these spikes should be much less as a balance is achieved. Usually, only a 1/4 turn, or less, is needed to obtain the proper adjustment for best noise balance. If a proper balance cannot be achieved, repeat the IF and RF alignments and then try the noise balance adjustment again.

3-6 EQUIPMENT REQUIRED — TRANSMITTER ALIGNMENT

3-6-1 RF Wattmeter (or any equivalent device which provides a 50 ohm load at the appropriate power range).

3-6-2 Frequency Counter - 170 MHz preferred; 50 MHz acceptable.

3-6-3 FM Modulation Meter - Lampkin 205A or equivalent peak reading deviation meter.

3-6-4 Audio Generator - HP 200CD or equivalent.

3-6-5 VTVM

3-7 TRANSMITTER TUNING PROCEDURE

NOTE: The encircled numbers on diagram 4-14 correspond to the last digit in the following procedure steps. The unit must be connected to a suitable 50 ohm load for proper alignment of the final transmitter stage.

3-7-1 Install crystals. For full bandwidth alignment, a center tune-up crystal must be used. Alignment is done on the center tune-up frequency and then the bandwidth is checked using the high and low crystals. The total maximum bandwidth for Transmitter operation is 1.0 MHz (500 KHz above and 500 KHz below the tune-up frequency).

3-7-2 Tighten trimmer capacitor C303.

3-7-3 Set the "Netting" capacitor(s) (see diagram 1-4) to mid-range.

3-7-4 With the transmitter keyed and the center frequency crystal operating, voltage at this point should be 2.5 to 3.0 volts as read on a VTVM.

3-7-5 Move the VTVM's probe to this point and adjust L306 for maximum reading (0.8 to 1.2 volts).

3-7-6 Move the VTVM's probe to this point. Alternately peak the upper and lower cores of T305 for a maximum reading (normally 1.3 to 2.0 volts; however, if T304 is completely detuned, this voltage can be as low as 0.4 volts). Check this reading at the lowest and highest crystal frequencies installed for proper band-pass alignment.

Repeat steps 3-7-5 and 3-7-6 until no further improvement can be made. After these adjustments have been made, L306 and the primary (bottom core) of T305 should not be changed during the remainder of the alignment procedure.

NOTE: The frequency of the oscillator will change slightly whenever L306 and T305 are adjusted. Therefore, if the adjustment of these parts is ever changed, it is important to perform the Crystal Netting Procedure, 3-8.

3-7-7 Set the top core (secondary) of T304 flush with the top of the coil form. With the VTVM probe on T.P. 6, adjust the lower core (primary) of T304 for a minimum voltage. This dip will be fairly sharp and will reduce the voltage at T.P. 6 to approximately 1.5 volts. Move the VTVM probe to T.P. 7. Adjust the top core of T304 downward until the voltage on T.P. 7 is 0.3 to 0.6 volts. The voltage at this point must not exceed 0.6 volts and the top core of T304 must be toward the top of the coil form relative to the secondary winding of T304.

3-7-8 With the VTVM probe on T.P. 7, adjust the lower core (primary) of T303 for a minimum voltage. Adjust the top core (secondary) of T303 for maximum power output on the Wattmeter. During Power Amplifier alignment, the secondary of T303 is retouched for maximum power. At that time, the voltages at T.P. 7 should be rechecked and the top core of T304 readjusted, if necessary, as in 3-7-7 above.

NOTE: If the Power Amplifier Stage (Q301) is detuned to the extent that no power indication can be obtained, the following procedure can be used to set the top core of T303 near its correct position; move the VTVM's probe to Test Point 8. Adjust the top core of T303 for a MINIMUM voltage at this point. Now proceed with 3-7-9 and the rest of the Tuning Procedure. With the transmitter delivering rated output power, the voltage drop across R329 will normally be 0.9 to 1.2 volts.

3-7-9 Set the core of T302 to the center of the coil winding.

3-7-10 Power Amplifier Alignment:

NOTE: It is desirable, during Power Amplifier Alignment, to place the unit, especially the transmitter section, on a sheet of steel to simulate the presence of the unit's cover. This sheet should be large enough so that it completely covers the bottom of the transmitter board and protrudes beyond the chassis on both sides. Do not permit this sheet to touch any part protruding below the transmitter board.

a. Set C303 almost tight.

b. The following adjustments are peaked in the order listed for maximum power output as indicated on the R.F. Wattmeter.

   1.) Peak C303
   2.) Peak C308
   3.) Repeat the above two steps until no further improvement is noted.
   4.) Repeak the top core of T303 (secondary) as in 3-7-8 above.

c. Check bandwidth with low and high frequency crystals. Adjust T303 for best output compromise between high and low limits. Adjusting the core of T302 will sometimes help widen the bandwidth. C308 is final adjustment for best compromise over the frequency range.

3-8 CRYSTAL NETTING PROCEDURE

NOTE: The following procedures should be performed with the unit at a temperature of 70 to 80°F. The frequency of each channel must be set to within ±.0001% of the assigned channel frequency. The crystal heater should not be in operation at this ambient temperature. Check to make certain that it is turned off before proceeding further with crystal netting. The voltage drop across R334 (or R335) is zero volts when the crystal heater is off. A useful operational check (after the crystals are netted) is to spray RT-301 with a "cold" spray, lowering its temperature below the heater's turn on point of approximately 30°F. When this is done, the crystal heaters should turn on, as evidenced by Q310 being saturated (low collector voltage).

3-8-1 Use the following procedure if a 170 MHz Counter is available:

a. Connect the unit to the RF Wattmeter or Dummy load.

b. Turn transmitter on (key the mike's PTT Switch or ground pin No. 2 of J2).

c. Place an RF pick-up loop consisting of 3 or 4 turns near the final transistor's output circuit (near L301; see diagram 4-9).

d. Read the frequency on the counter.

e. Adjust the appropriate netting capacitor (C335, C337, C339, C341; see diagram 4-9 for their location) until the frequency being read on the counter is "ON" channel.

3-8-2 Use the following procedure if only a 50 MHz Counter is available:

a. Connect the unit to the RF Wattmeter or Dummy load.

b. Turn transmitter on.

c. Place an RF pick-up loop near the top of coil T305.

NOTE: Due to the possible slight "pulling" of the crystal's frequency, couple the pick-up loop as lightly as possible to T305. Excessive coupling to the bottom coil will prevent a proper crystal netting adjustment from being made. Use the maximum sensitivity available at the counter's input.

d. Multiply the frequency read on the counter by four (4) to find the ultimate frequency being transmitted.

EXAMPLE:
Frequency read = 39.200 00 MHz

Ultimate Frequency = 4 x 39.200 000 = 156.800 MHz

e. Adjust the appropriate netting capacitor until the frequency being read is within the required tolerance at one-fourth (1/4) of the ultimate transmitted frequency.

EXAMPLE:
Ultimate Frequency = 156.800 MHz

Counter Reading = 156.800 MHz = 39.200 000 MHz ±.0001%

3-9 DEVIATION ADJUSTMENT

3-9-1 Use the following procedure for proper adjustment of the Deviation (R244) control:

a. Connect the unit to the RF Wattmeter or Dummy load.

b. Connect the Audio Generator to the mike input terminals. Set the audio voltage level to 0.5-1.0 volts RMS at 1000 Hz.

c. Couple the FM Modulation Meter's RF pick-up to the transmitter.

d. Key the transmitter and adjust R244 (Deviation Control) so that the maximum deviation is no greater than 5 KHz.

e. Reduce the audio input level to 0.25 volts RMS. The deviation should not be greater than 5 KHz.

SECTION 4 DIAGRAMS, VOLTAGE DATA AND SCHEMATIC

4-1 RF — TRANSMITTER AUDIO BOARD PARTS PLACEMENT DIAGRAM

4-2 RF — TRANSMITTER AUDIO BOARD BOTTOM VIEW

4-3 DIODE SWITCHING BOARD PARTS PLACEMENT DIAGRAM

4-4 DIODE SWITCHING BOARD BOTTOM VIEW

4-5 IF — AUDIO BOARD PARTS PLACEMENT DIAGRAM

4-6 IF — AUDIO BOARD BOTTOM VIEW

4-7 LED DISPLAY BOARDS PARTS PLACEMENT DIAGRAMS

4-8 LED DISPLAY BOARDS BOTTOM VIEWS

4-9 TRANSMITTER BOARD PARTS PLACEMENT DIAGRAM

4-10 TRANSMITTER BOARD BOTTOM VIEW

4-11 RELAY BOARD PARTS PLACEMENT DIAGRAM

4-12 RELAY BOARD BOTTOM VIEW

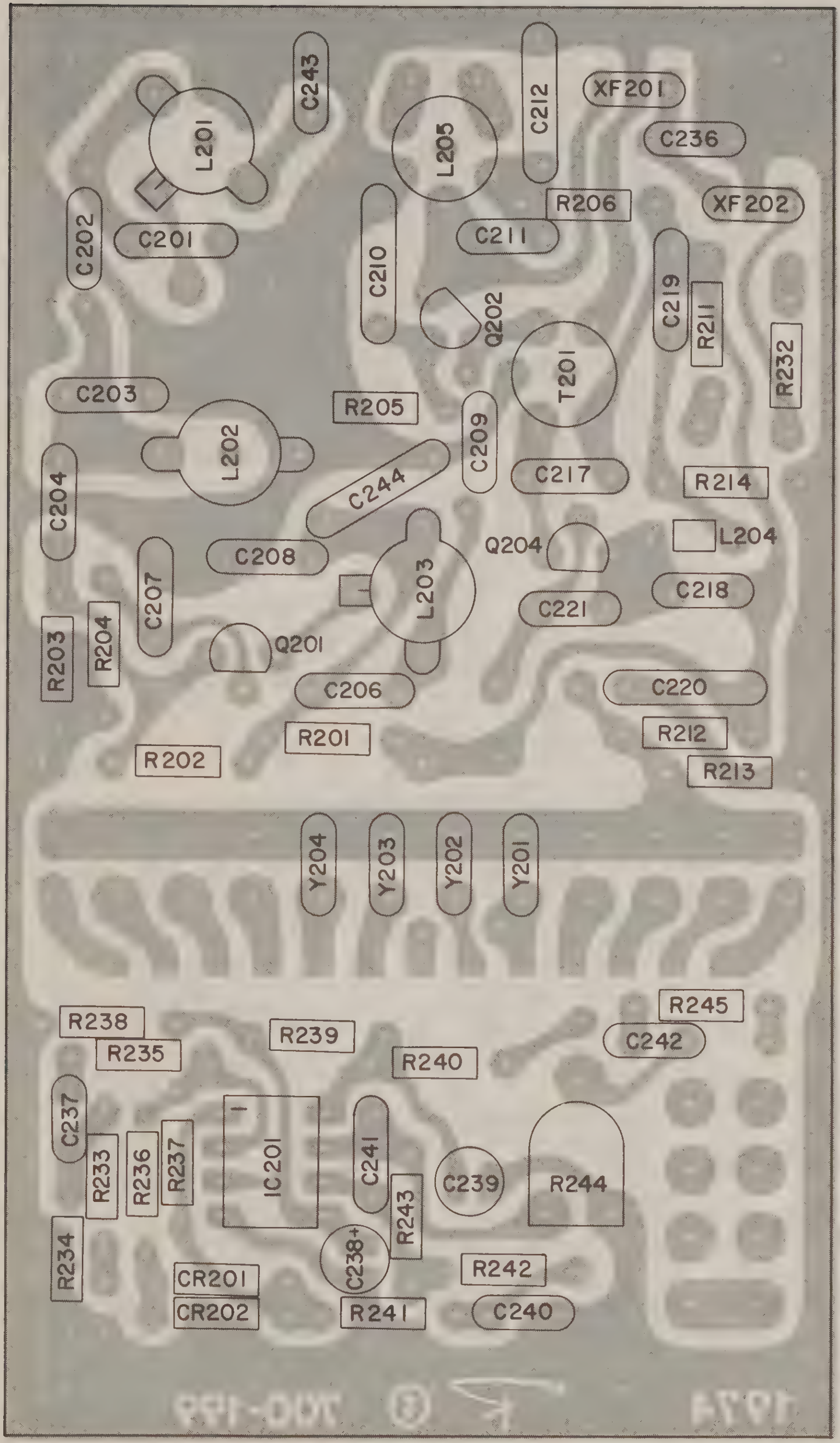
4-13 TRANSMITTER BOARD TUNE-UP TEST POINTS

4-14 CRYSTAL LOCATION AND ADJUSTMENT DIAGRAM

4-15 VOLTAGE DATA

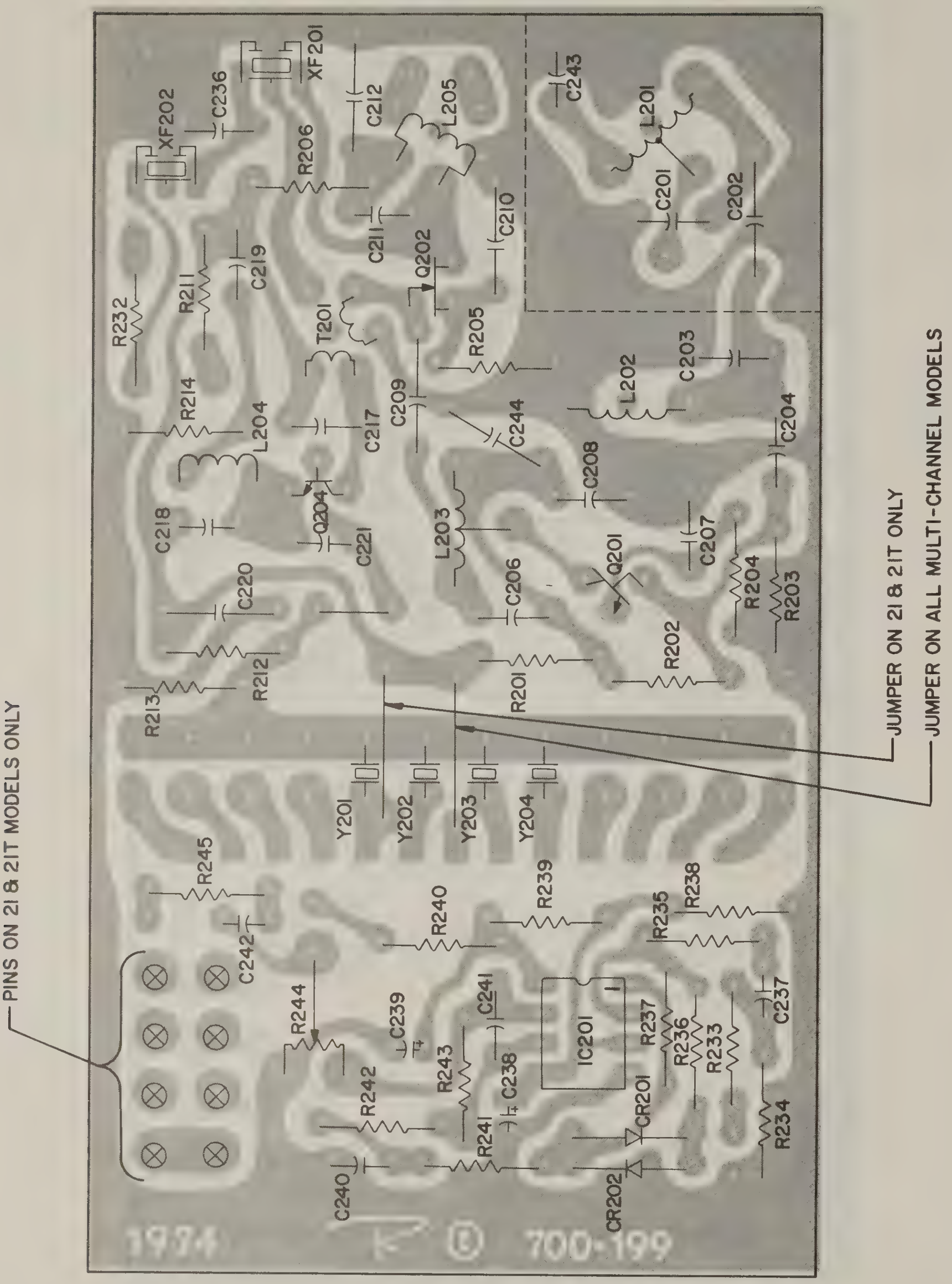
4-16 SCHEMATIC

RF BOARD 700-199

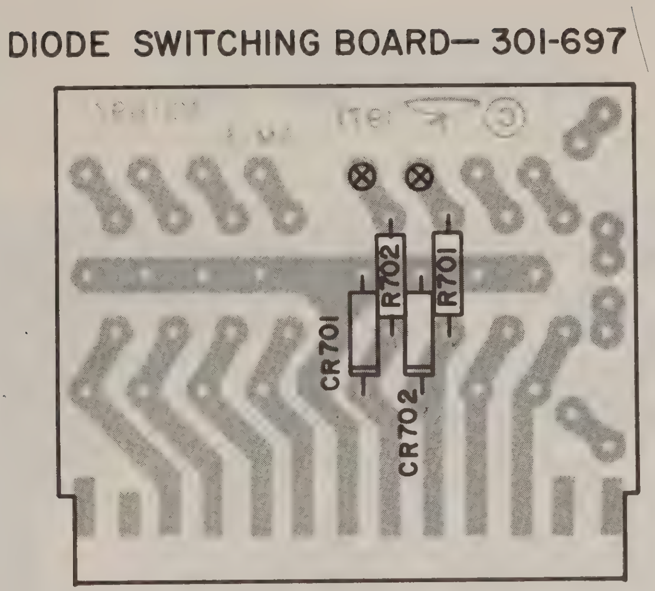


4-1 RF — TRANSMITTER AUDIO BOARD PARTS PLACEMENT DIAGRAM

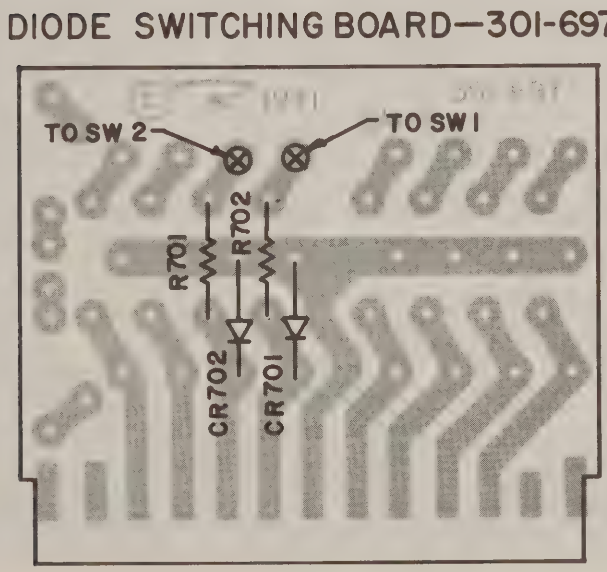
RF BD. 700-199



4-2 RF — TRANSMITTER AUDIO BOARD BOTTOM VIEW

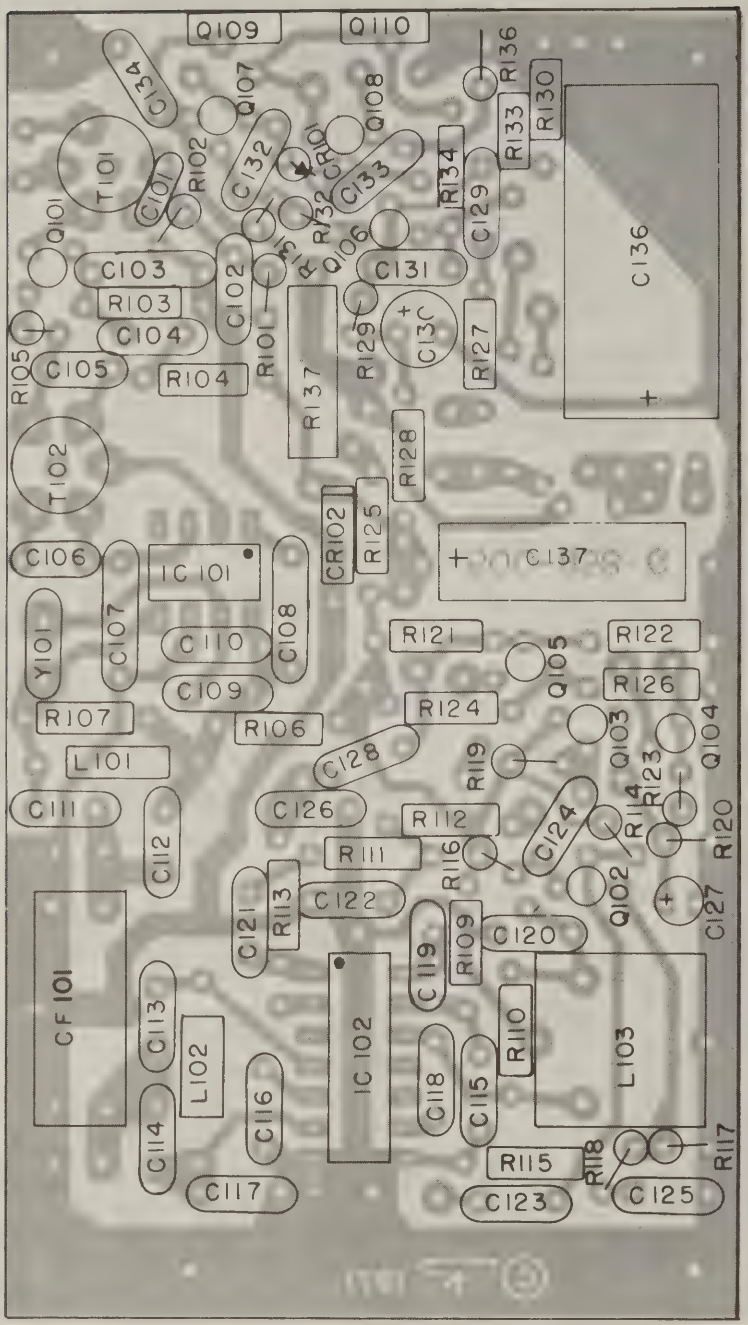


4-3 DIODE SWITCHING BOARD PARTS PLACEMENT DIAGRAM



4-4 DIODE SWITCHING BOARD BOTTOM VIEW

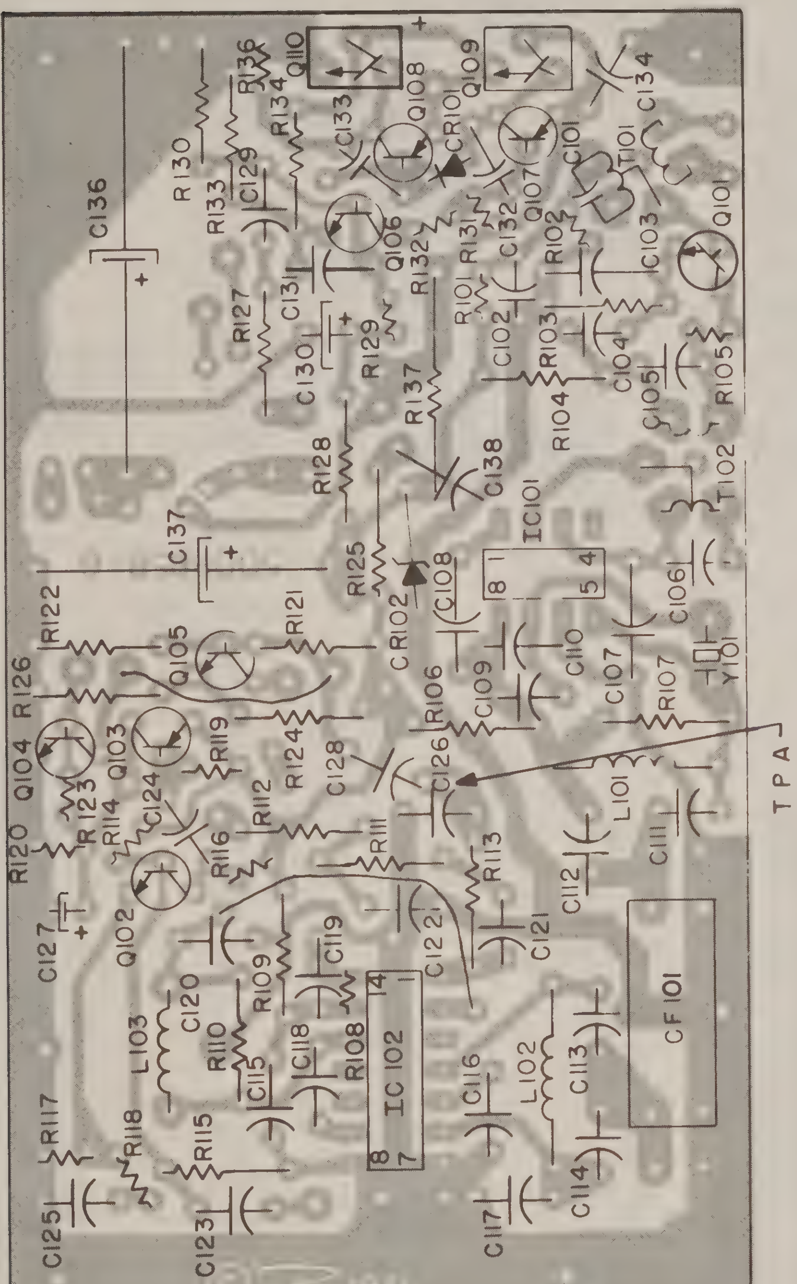
IF BOARD 500-858



NOTE: R108 & C138 ARE ON THE BOTTOM OF THE BOARD

4-5 IF — AUDIO BOARD PARTS PLACEMENT DIAGRAM

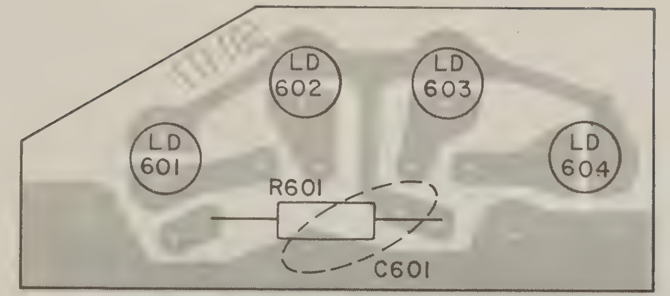
IF BOARD 500-858



NOTE: R108 & C138 ARE ON THE BOTTOM OF THE BOARD

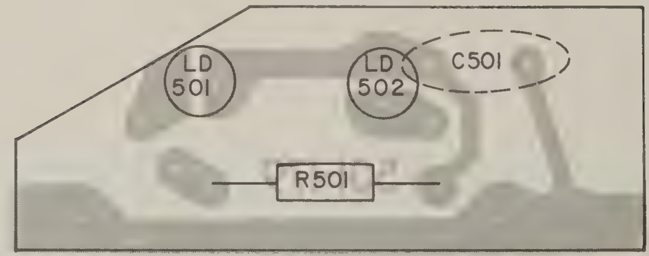
4-6 IF — AUDIO BOARD BOTTOM VIEW

L.E.D. BOARD— 501-177



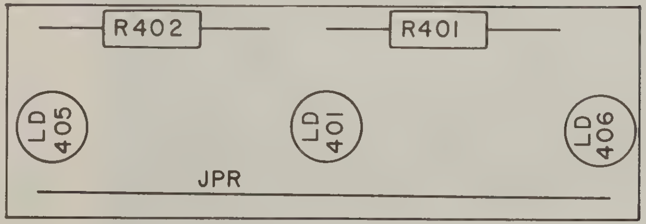
THIS BOARD USED ON MICRO-COM 24 & 24S
C601 IS LOCATED ON BOTTOM OF BOARD

L.E.D. BOARD— 501-179



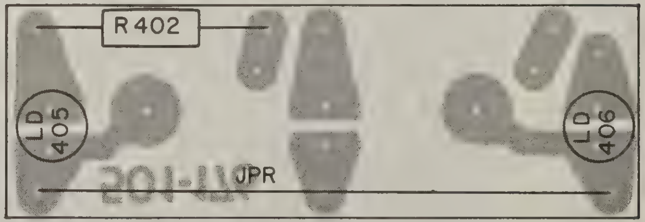
THIS BOARD USED ON MICRO-COM 22
C501 IS LOCATED ON BOTTOM OF BOARD

L.E.D. BOARD— 501-176



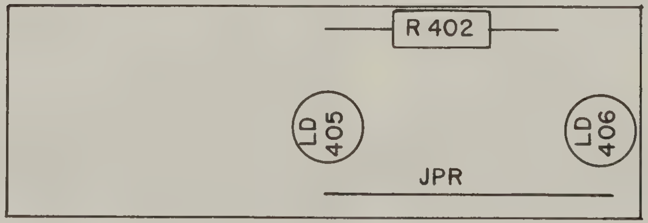
THIS CONFIGURATION FOR MICRO-COM 21T

L.E.D. BOARD— 501-176



THIS CONFIGURATION FOR MICRO-COM 21

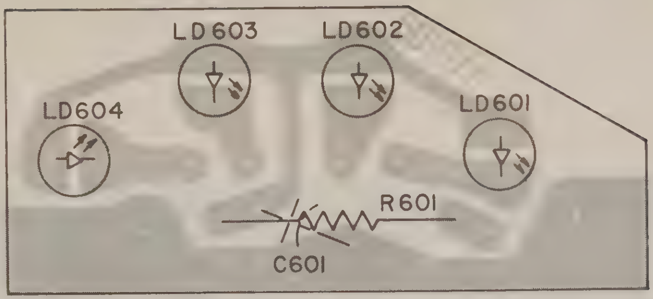
L.E.D BOARD— 501-176



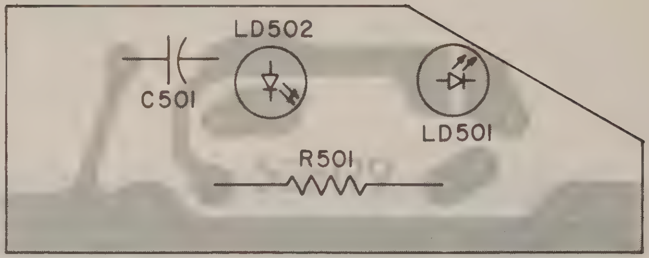
THIS CONFIGURATION COMMON TO MICRO-COM 22,24 & 24S

4-7 LED DISPLAY BOARDS PARTS PLACEMENT DIAGRAMS

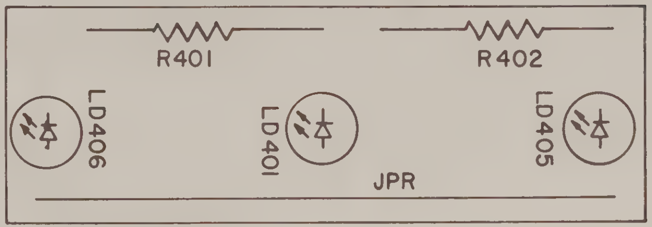
L.E.D. BOARD — 501-177



L.E.D. BOARD - 501-179

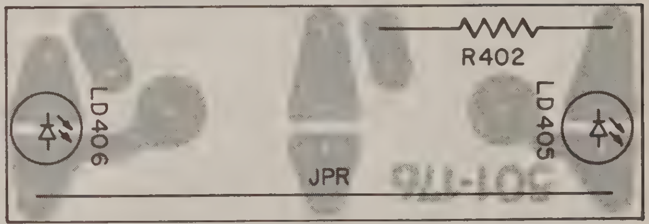


L.E.D. BOARD — 501-176



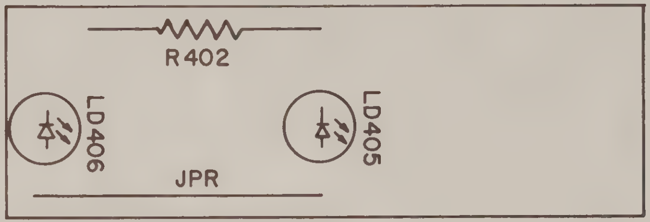
FOR MICRO-COM 21T

L.E.D. BOARD - 501-176



FOR MICRO-COM 21

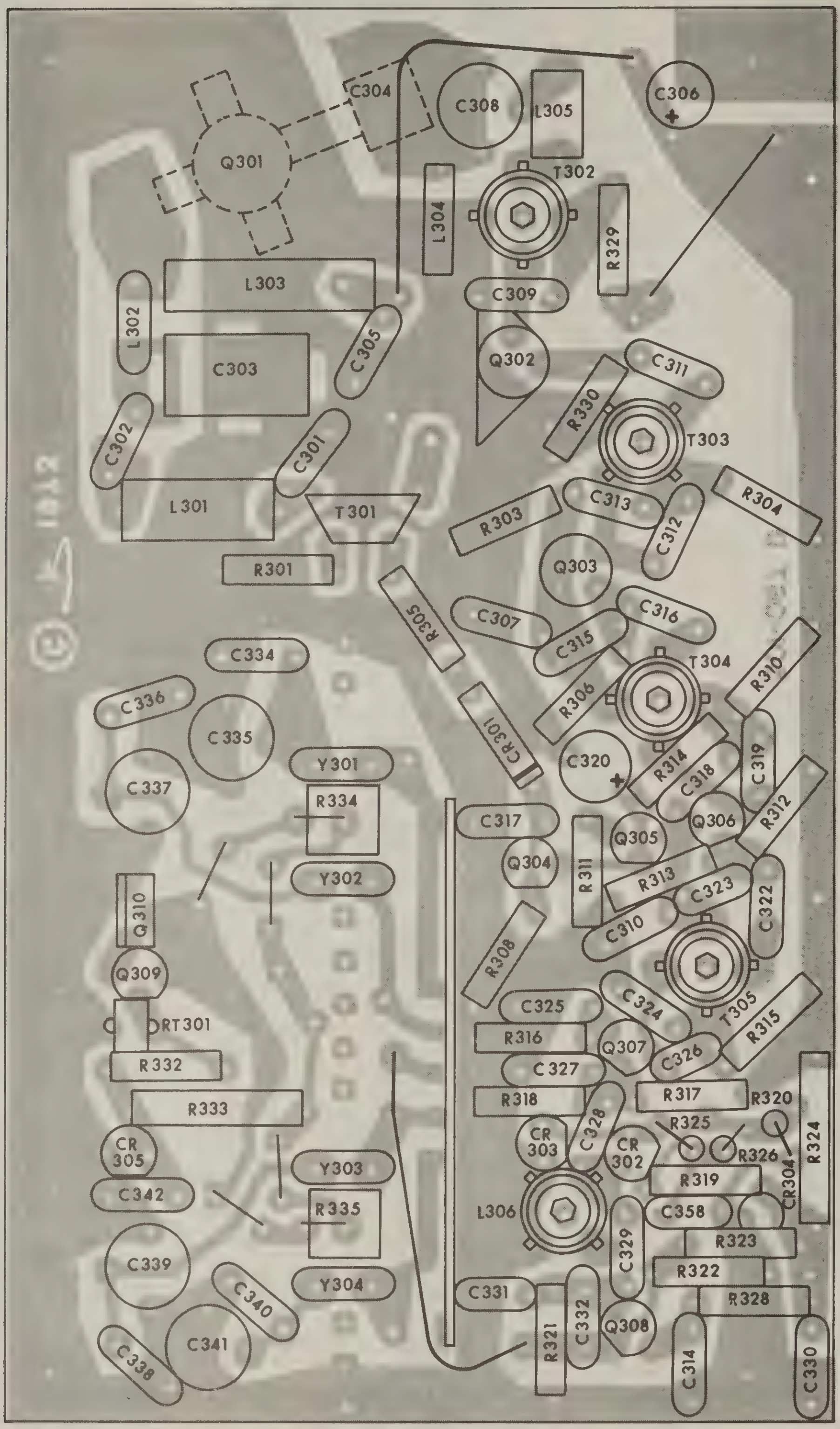
L.E.D. BOARD - 501-176



FOR MICRO-COM 22,24& 24S

4-8 LED DISPLAY BOARDS BOTTOM VIEWS

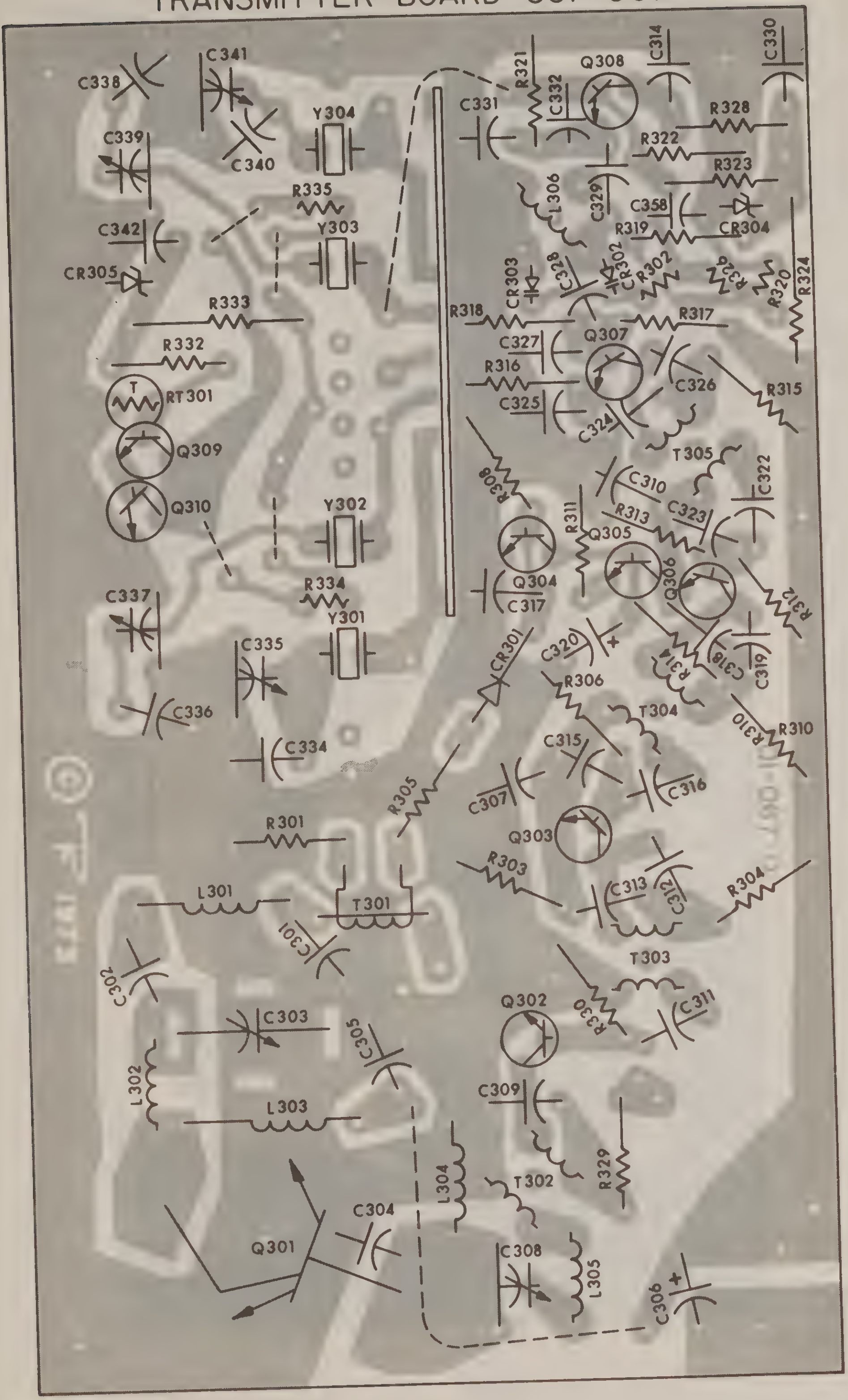
TRANSMITTER BOARD 501-067



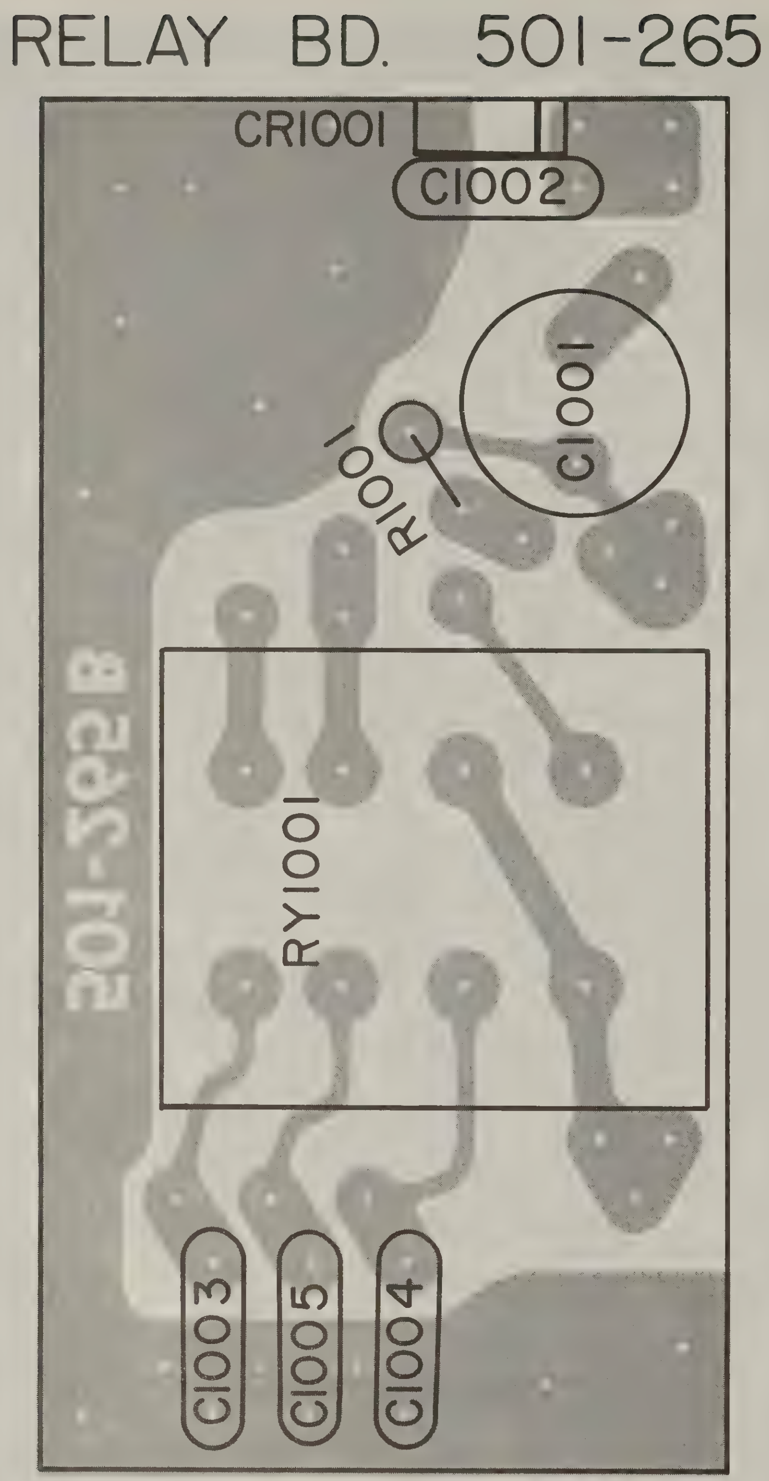
NOTE: Q301 & C304 ARE MOUNTED ON BOTTOM SIDE OF BOARD.

4-9 TRANSMITTER BOARD PARTS PLACEMENT DIAGRAM

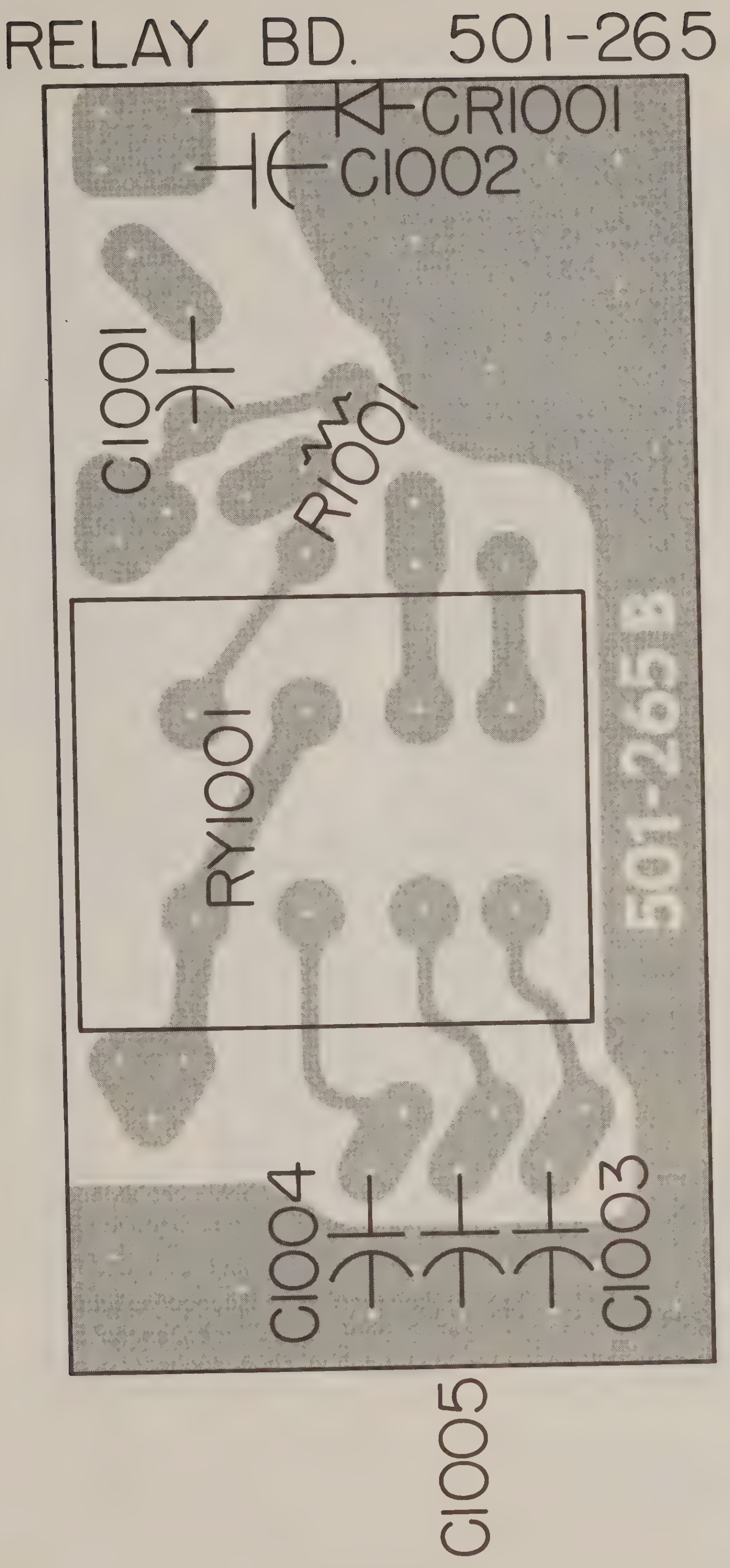
TRANSMITTER BOARD 501–067



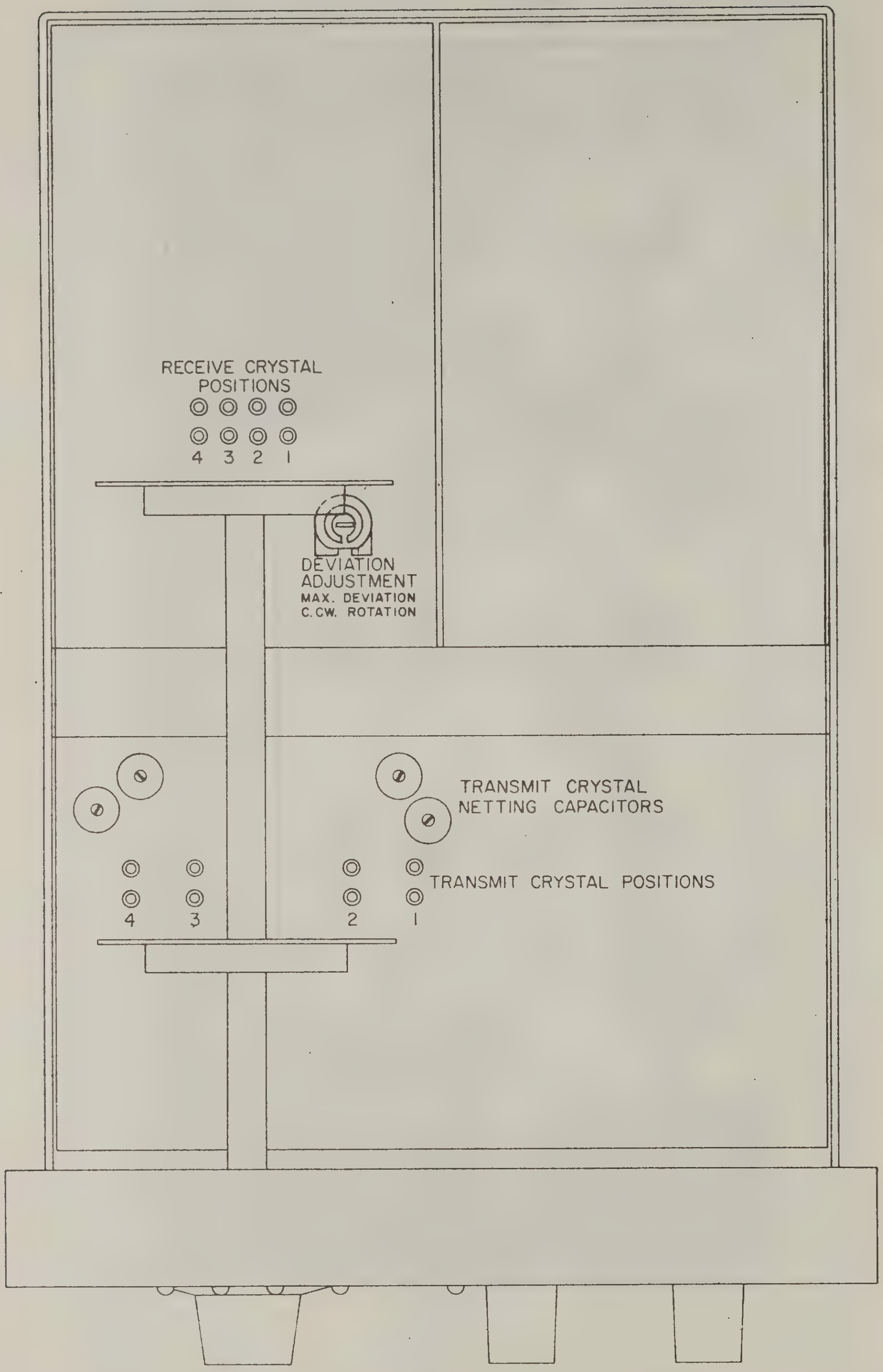
4-10 TRANSMITTER BOARD BOTTOM VIEW



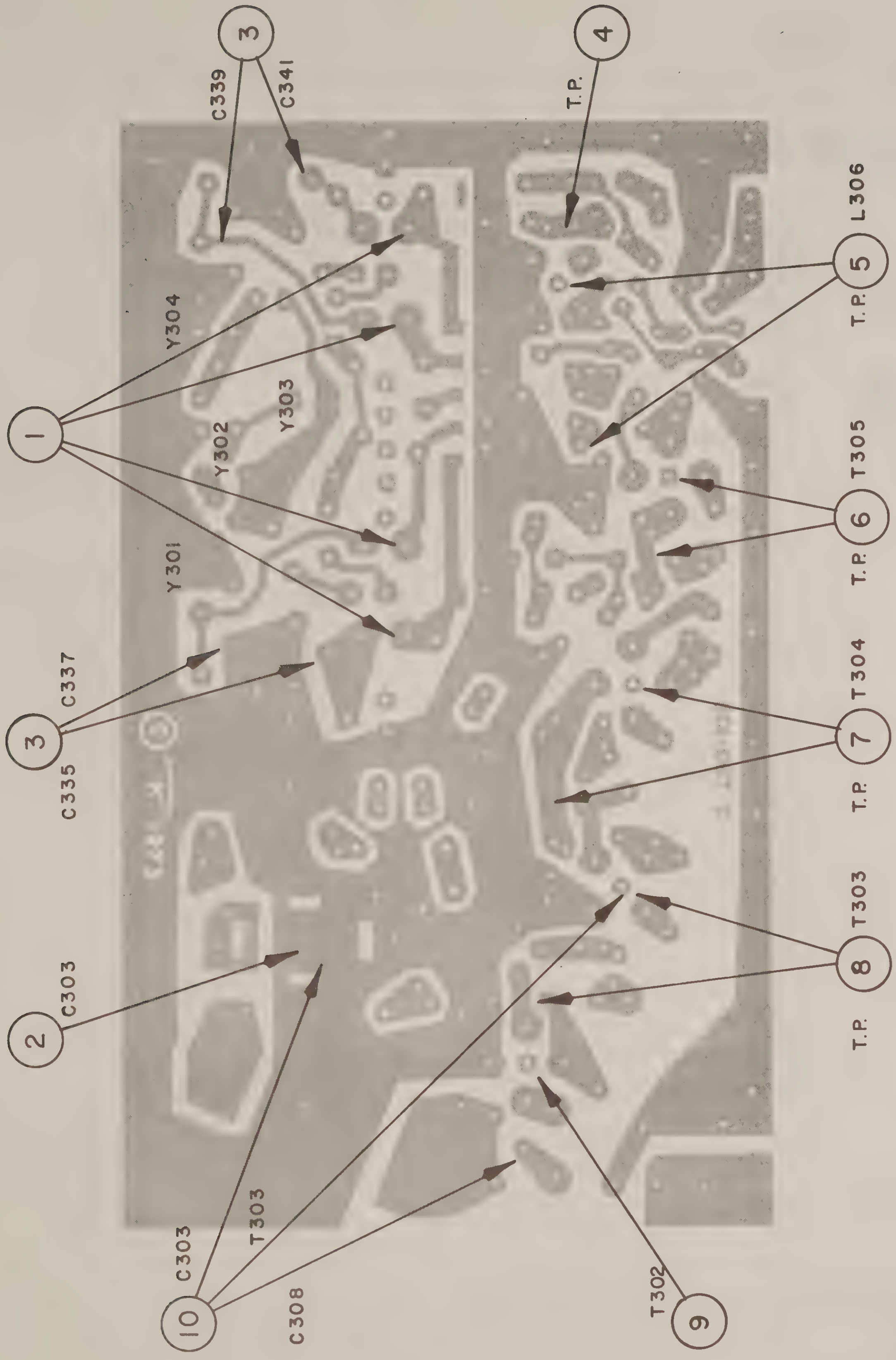
4-11 RELAY BOARD PARTS PLACEMENT DIAGRAM



4-12 RELAY BOARD BOTTOM VIEW


RECEIVE CRYSTAL POSITIONS
4
3
2
1
DEVIATION ADJUSTMENT
MAX. DEVIATION C.CW. ROTATION
TRANSMIT CRYSTAL NETTING CAPACITORS
TRANSMIT CRYSTAL POSITIONS
4
3
2
1

4-13 CRYSTAL LOCATION AND ADJUSTMENT DIAGRAM



4-14 TRANSMITTER BOARD TUNE-UP TEST POINTS

4-15 VOLTAGE DATA

NOTE: All voltages are nominal and were measured with a VTVM, 13.8 VDC supply voltage.

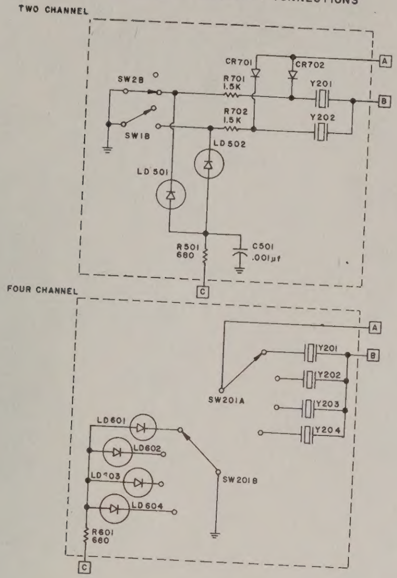
VOLTAGE DATA — TRANSISTORS

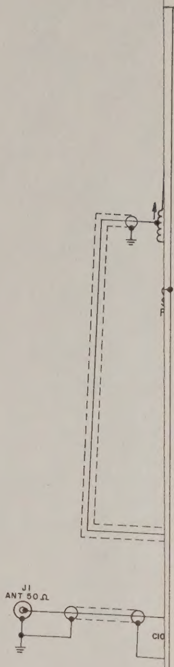
	Transistor	Emitter (Source)	Base (Gate)	Collector (Drain)
RF BOARD No. 500-861	Q201	3.8	4.5	6.9
	Q202 (FET)	1.0	0	6.2
	Q204	4.4	5.0	7.2
IF BOARD No. 500-858	Q101	2.3	3.0	7.3
	Q102	1.0	1.7	4.8
	Q103 (PNP)	8.2	8.2	0 (Unsquelched)
		8.2	8.2	1.0 (Squelched)
		8.2	8.2	1.5 min. (tight squelch)
	Q104	0	0	1.9 (Unsquelched)
		0	0.80	0.30 (Squelched)
		0	0.80	1.10 (tight squelch)
	Q105	1.4	1.9	5.1 (Unsquelched)
		1.1	0.10	8.2 (tight squelch)
	Q106	0.7	1.3	12.4
	Q107 (PNP)	13.8	13.3	7.2
	Q108 (PNP)	6.9	6.6	0.10
	Q109	6.9	7.2	13.8
	Q110	0	0.10	6.9
TX BOARD No. 501-067	Q301	0	−0.5	13.2
	Q302	0	−0.4	12.1
	Q303	0.50	−0.2	12.4
	Q304	0	0.33	2.3
	Q305	1.4	2.3	1.6
	Q306	1.6	1.0	13.1
	Q307	1.9	1.4	12.2
	Q308	2.6	2.8	8.2
	Q309	—	0.6	13.8 (OFF — Ambient Temperature = 70° to 80°F)
		—	1.4	0.7 (ON — Ambient Temperature less than 17°F)
	Q310	0	—	13.8 (OFF)
		0	—	0.7 (ON)

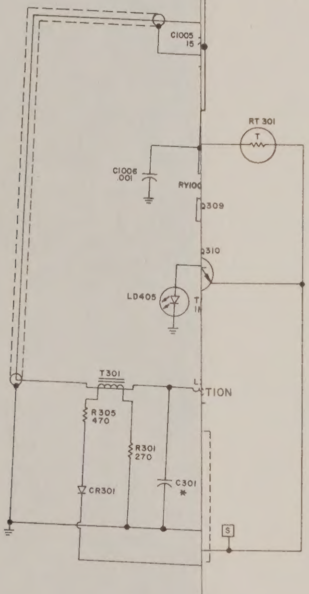
VOLTAGE DATA — INTEGRATED CIRCUITS

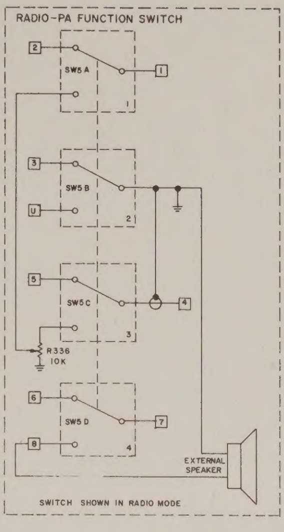
IC No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC 101	4.2	0.7	0.7	4.2	7.8	0	4.2	7.8	—	—	—	—	—	—
IC 102	4.0	3.5	0	1.3	1.3	1.3	0	0	0.2	1.6	2.9	3.5	7.6	5.0
IC 201	4.1	4.1	4.1	0	4.1	4.1	4.1	8.2	—	—	—	—	—	—

RECEIVER MULTI-FREQUENCY CONNECTIONS





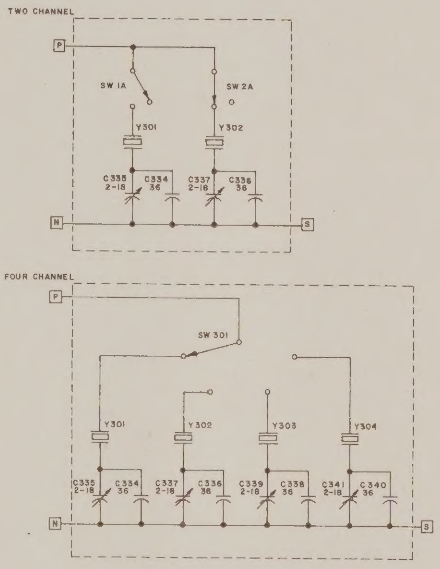




NOTES:

1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
   ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS.
   ALL RESISTOR NOT SPECIFIED OTHERWISE ARE 1/4 WATT.
2. ✪ NOTED VALUES ARE FACTORY SELECTED. NOMINAL VALUES SHOWN.
3. PARTS MARKED WITH ✱ ARE VARIABLE WITH MODEL SEE ABOVE CHART FOR VALUES.
4. CIRCUIT BOARD MODIFICATION ON:
   A. MICRO-COM 21T WITH PA OPTION
   B. MICRO-COM 21 WITH PA OPTION
5. PART NUMBERS INDICATE LOCATION
   0-99 CHASSIS MOUNTED
   100-199 IF BOARD
   200-299 RECEIVER RF BOARD
   300-399 TRANSMITTER BOARD
   400-499 LED INDICATOR BOARD
   500-599 LED DISPLAY BOARD 2F
   600-699 LED DISPLAY BOARD 4F
   700-799 DIODE SWITCH BOARD
   1000-1099 RELAY BOARD

TRANSMITTER MULTI-FREQUENCY CONNECTIONS



4-16 SCHEMATIC

4-15 VOLTAGE DATA

NOTE: All voltages are nominal and were measured with a VTVM, 13.8 VDC supply voltage.

VOLTAGE DATA — TRANSISTORS

	Transistor	Emitter (Source)	Base (Gate)	Collector (Drain)
RF BOARD No. 500-861	Q201	3.8	4.5	6.9
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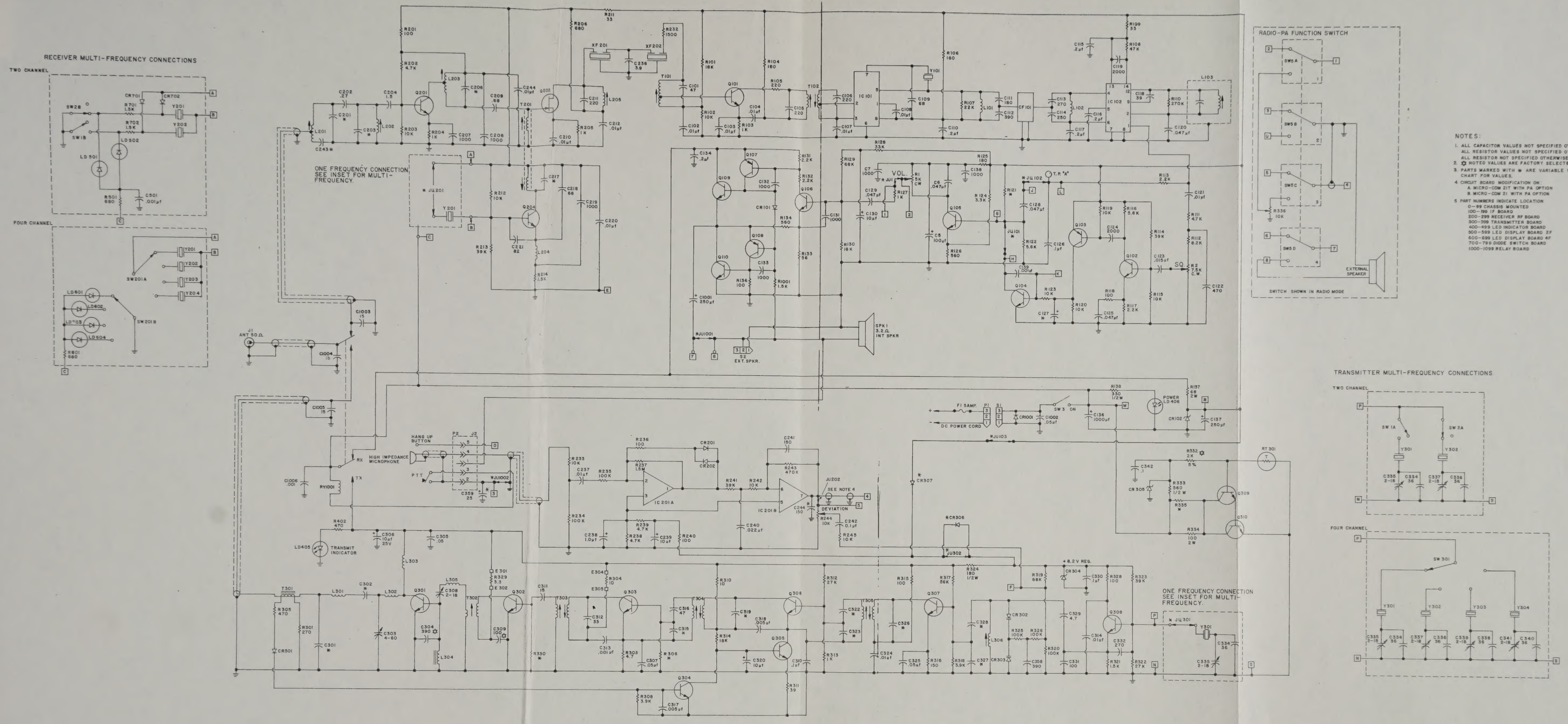
		8.2	8.2	1.5 min. (tight squelch)
	Q104	0	0	1.9 (Unsquelched)
		0	0.80	0.30 (Squelched)
		0	0.80	1.10 (tight squelch)
	Q105	1.4	1.9	5.1 (Unsquelched)
		1.1	0.10	8.2 (tight squelch)
	Q106	0.7	1.3	12.4
	Q107 (PNP)	13.8	13.3	7.2
	Q108 (PNP)	6.9	6.6	0.10
	Q109	6.9	7.2	13.8
	Q110	0	0.10	6.9
TX BOARD No. 501-067	Q301	0	−0.5	13.2
	Q302	0	−0.4	12.1
	Q303	0.50	−0.2	12.4
	Q304	0	0.33	2.3
	Q305	1.4	2.3	1.6
	Q306	1.6	1.0	13.1
	Q307	1.9	1.4	12.2
	Q308	2.6	2.8	8.2
	Q309	—	0.6	13.8 (OFF — Ambient Temperature = 70° to 80°F)
		—	1.4	0.7 (ON — Ambient Temperature less than 17°F)
	Q310	0	—	13.8 (OFF)
		0	—	0.7 (ON)

VOLTAGE DATA — INTEGRATED CIRCUITS

IC No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC 101	4.2	0.7	0.7	4.2	7.8	0	4.2	7.8	—	—	—	—	—	—
IC 102	4.0	3.5	0	1.3	1.3	1.3	0	0	0.2	1.6	2.9	3.5	7.6	5.0
IC 201	4.1	4.1	4.1	0	4.1	4.1	4.1	8.2	—	—	—	—	—	—



NOTES:

1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
   ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS.
   ALL RESISTOR NOT SPECIFIED OTHERWISE ARE 1/4 WATT.
2. ✡ NOTED VALUES ARE FACTORY SELECTED. NOMINAL VALUES SHOWN.
3. PARTS MARKED WITH * ARE VARIABLE WITH MODEL SEE ABOVE CHART FOR VALUES.
4. CIRCUIT BOARD MODIFICATION ON:
   - A. MICRO-COM 21T WITH PA OPTION
   - B. MICRO-COM 21 WITH PA OPTION
5. PART NUMBERS INDICATE LOCATION
   - 0–99 CHASSIS MOUNTED
   - 100–199 IF BOARD
   - 200–299 RECEIVER RF BOARD
   - 300–399 TRANSMITTER BOARD
   - 400–499 LED INDICATOR BOARD
   - 500–599 LED DISPLAY BOARD 2F
   - 600–699 LED DISPLAY BOARD 4F
   - 700–799 DIODE SWITCH BOARD
   - 1000–1099 RELAY BOARD

MODEL NO.	FREQ. RANGE	C201	C203	C206	C217	C127	R121	C328	C327	C326	C322	C323	C319	C315	R306	R330	C302	C301	JU101	JU102	JU201	JU301	R335	C243	JU1	JU103	JU302	JU1001	JU1002	JU202	C359	C244	CR306	CR307
MICRO-COM 21	150–162 MHz	10	8.2	5.6	18	5µf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	X	X	X	—	150	X	—	X	X	X	X	—	—	—	—
MICRO-COM 22	150–162 MHz	10	8.2	5.6	18	5µf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	X	—	—	—	150	X	—	X	X	X	X	—	—	—	—
MICRO-COM 24	150–162 MHz	10	8.2	5.6	18	5µf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	X	—	—	100-2W	150	X	—	X	X	X	X	—	—	—	—
MICRO-COM 21T	150–162 MHz	10	8.2	5.6	18	5µf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	—	X	X	—	150	X	—	X	X	X	X	—	—	—	—
MICRO-COM 24S	150–162 MHz	10	8.2	5.6	18	1µf	—	47	75	100	82	180	100	270	100	22	18	18	—	X	—	—	100-2W	150	X	—	X	X	X	X	—	—	—	—
MICRO-COM 21H	162–174 MHz	8.2	6.8	3.9	15	5µf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	X	X	X	—	100	X	—	X	X	X	X	—	—	—	—
MICRO-COM 22H	162–174 MHz	8.2	6.8	3.9	15	5µf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	X	—	—	—	100	X	—	X	X	X	X	—	—	—	—
MICRO-COM 24H	162–174 MHz	8.2	6.8	3.9	15	5µf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	X	—	—	100-2W	100	X	—	X	X	X	X	—	—	—	—
MICRO-COM 21TH	162–174 MHz	8.2	6.8	3.9	15	5µf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	—	X	X	—	100	X	—	X	X	X	X	—	—	—	—
MICRO-COM 21T/ PA	150–162 MHz	10	8.2	5.6	18	5uf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	—	X	X	—	150	—	X	—	—	—	—	X	X	X	X
(CTCSS)	162–174 MHz	8.2	6.8	3.9	15	5uf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	—	X	X	—	100	—	X	—	—	—	—	X	X	X	X
MICRO-COM 21T/ PA	150–162 MHz	10	8.2	5.6	18	5uf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	X	X	X	—	150	—	X	—	—	—	—	X	X	X	X
(TTS)	162–174 MHz	8.2	6.8	3.9	15	5uf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	X	X	X	—	100	—	X	—	—	—	—	X	X	X	X
MICRO-COM 21 / PA	150–162 MHz	10	8.2	5.6	18	5uf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	X	X	X	—	150	—	X	—	—	—	—	X	X	X	X
	162–174 MHz	8.2	6.8	3.9	15	5uf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	X	X	X	—	100	—	X	—	—	—	—	X	X	X	X
MICRO-COM 21T	150–162 MHz	10	8.2	5.6	18	5uf	✡18K	47	75	100	82	180	100	270	100	22	18	18	X	X	X	X	—	150	X	—	X	X	X	X	—	—	—	—
(TTS)	162–174 MHz	8.2	6.8	3.9	15	5uf	✡18K	36	100	180	120	390	82	100	270	47	15	15	X	X	X	X	—	100	X	—	X	X	X	X	—	—	—	—

4-16 SCHEMATIC